FEBRUARY 8, 1954

Electrical World

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A. C. Monteith . . .

vice-president in charge of engineering, Westinghouse Electric Corp, has been nominated for the presidency of the American Institute of Electrical Engineers for the year, 1954-55.

AIEE's 1954 Winter General Meeting at New York set three records . . .

A record of 96 sessions at which . . .

a record 412 papers . . .

were given to a record attendance of 4,958

See Editors' report page 74

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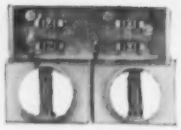

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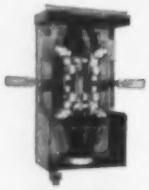

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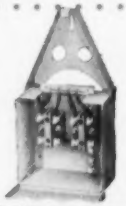

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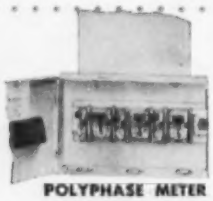

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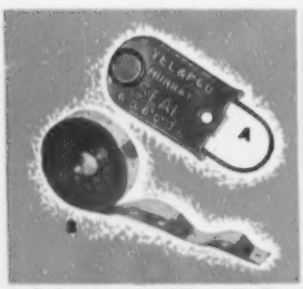

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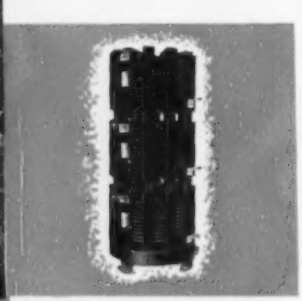

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This Week's Authors

Writing for Electrical World is nothing new for C. H. Hoffman, senior engineer in the electric distribution department of Public Service Electric & Gas Co. Hoffman's article on how to improve overall stability of an electric system (page 80) is his second for the magazine. His first, entitled "System Stability Needs Constant Attention," appeared Jan. 11. Hoffman, 37, lives in Sea Girt, N. J., is married, and has a son aged 7 and a daughter, 5.

C. H. HOFFMAN

J. D. Moynihan, who discusses on page 85 the importance of power line noise in application of carrier communication equipment, is an electric utility engineer for Westinghouse Electric Corp. which he joined in 1947.

While with Westinghouse he has worked with communication systems engineering for utilities.

He served with the Signal Corps in World War II.

J. D. MOYNIHAN

How full-scale tests prove Bonneville Power Administration's 345-kv tower design is described on page 82 by A. A. Osipovich, chief of transmission design section of BPA.

Born in Russia, he was graduated from Odessa Institute of Economics in 1921. Two years later he came to the U. S. He joined BPA in 1938.

A. A. OSIPOVICH

Electrical World

Published for 80 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

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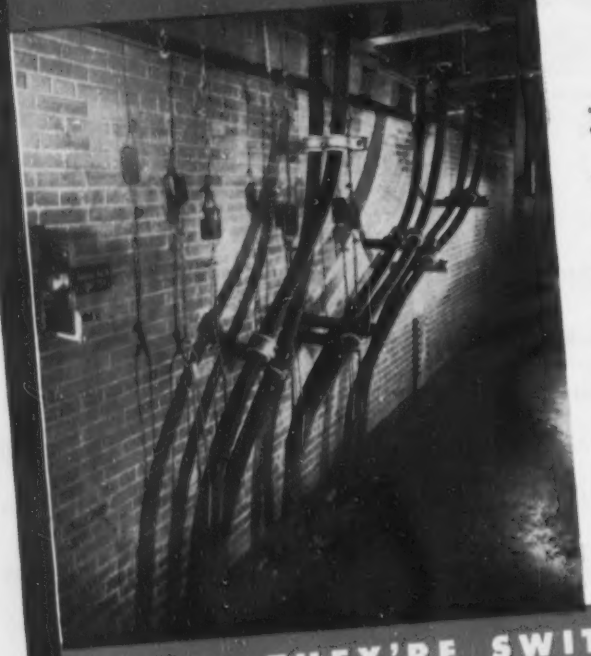
case history



no oil migration

This series of Okolite-Okoprene equalizer bus ties is installed in the Cincinnati Gas and Electric Company's West End Station. One of the reasons for choosing this cable design for vertical runs is that it eliminates oil migration problems inherent in varnished cambric and paper-insulated constructions. This feature is just one reason why today's best buy in high voltage cables is Okolite-Okoprene.

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rubber-insulated cables for use up to 35,000 volts

There is a distinct trend among industrials and public utilities toward Okolite rubber-insulated cables for high voltage use.

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1. **Lighter and easier handling.**
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5. **No oil migration at high temperatures or elevations.**
6. **Flexibility simplifies installation.**

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1. **Transmission and distribution circuits.**
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3. **Vertical risers and shaft cables.**
4. **Submarine power cables.**
5. **Portable substation cables and test leads.**
6. **X-ray cables.**

Send for this 128-page manual on rubber-insulated high voltage cable. It provides current carrying capacity tables, dimensional data, engineering information and installation procedures, complete instructions and detailed drawings for splices and terminations. Write for Bulletin EW-1075 on your letterhead to The Okonite Company, Passaic, New Jersey.

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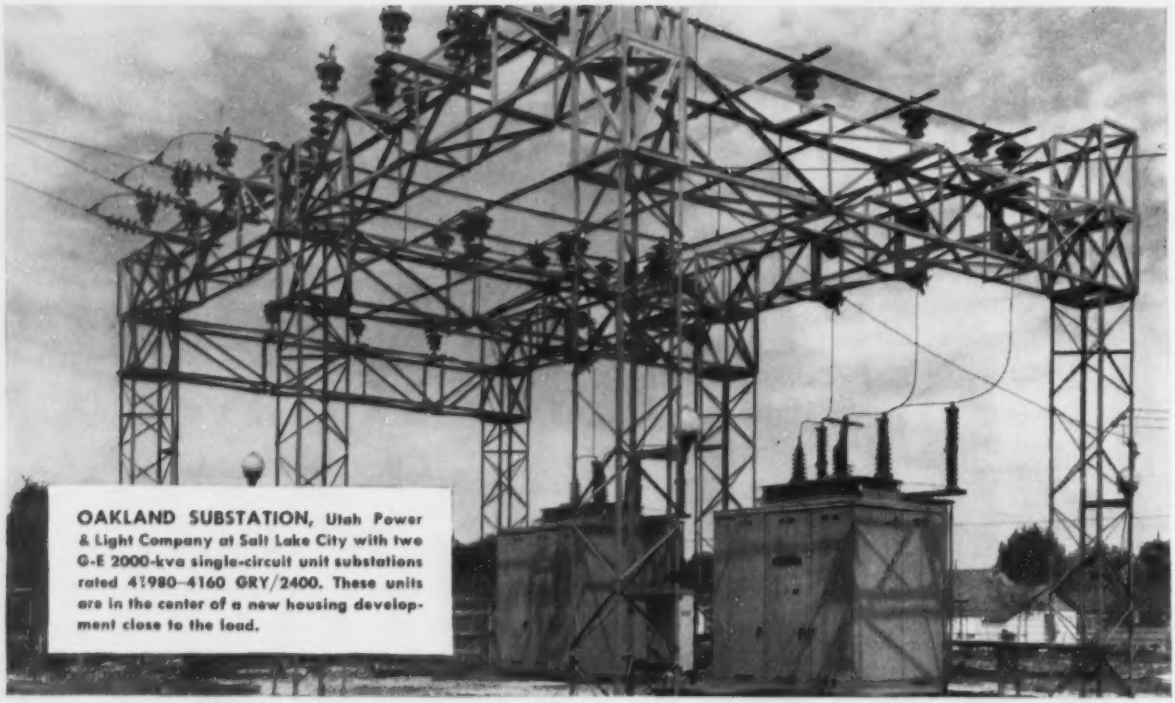


OAKLAND SUBSTATION, Utah Power & Light Company at Salt Lake City with two G-E 2000-kva single-circuit unit substations rated 4!980–4160 GRY/2400. These units are in the center of a new housing development close to the load.

When load doubles in new housing area . . .

Utah Power & Light Company meets demand with G-E single-circuit unit substations

2000-kva units conserve space, permit shorter lines, reduce installation, maintenance costs

To meet the tremendously increased power demand that has developed in Salt Lake City since World War II, Utah Power & Light Company has now standardized on the use of single-circuit unit substations. Ten years ago there were only three unit subs in the area . . . now there are twenty.

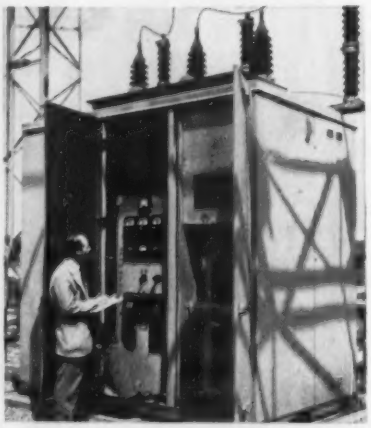
Load-growth problems simplified with G-E single-circuit unit substations because they incorporate transformer, vertical lift magne-blast air circuit breaker, load-ratio-control with voltage regulation, meters and other necessary instruments in a single, fully co-ordinated enclosure. They permit:

- Lower land cost because they require minimum space.
- Shorter lines because they can be located close to load.
- High re-use value because units may be easily shifted if the load changes or is seasonal.

Low and predictable installed cost, because there is nothing else to buy . . . nothing to overlook. Purchasing is simplified . . . only one specification, one purchase transaction. Repeat orders can be placed without further engineering or specification writing.

Standard ratings. G-E integral type unit substations are furnished in ratings from 12 to 66 kv incoming voltage. They have their widest application in areas of light-load-density where a single 2.5- or 4.33-kv feeder with 1000 to 3000 kva of load is to be served, or in the 15-kv class for loads of 1000 to 5000 kva.

If you are faced with load growth problems, investigate G-E single-circuit integral unit substations. For full information get in touch with your nearest G-E Sales Representative, or write General Electric Company, Section 422-7, Schenectady 5, N. Y.



DWANE G. JENSEN, Substation Supervisor, Salt Lake City Division, Utah Power & Light Company, inspects one of the new G-E single-circuit substations.

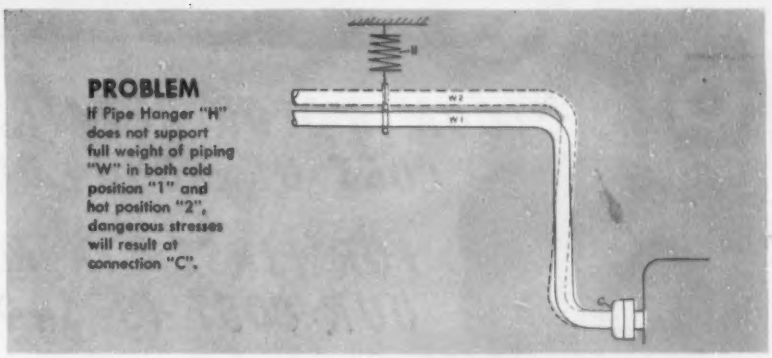
You can put your confidence in—

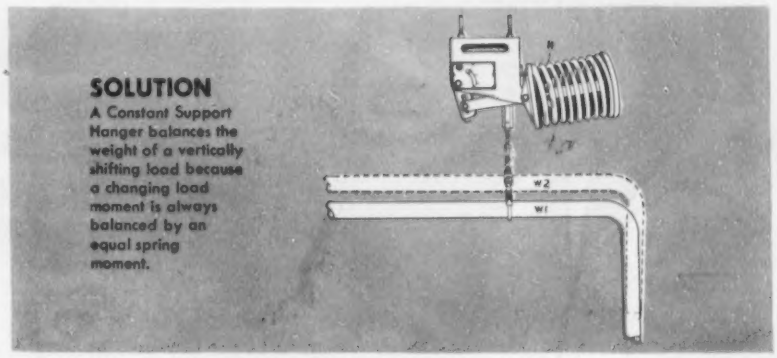
GENERAL ELECTRIC

Keeping Thermal Expansion Under Control

(ADVERTISEMENT)

Flexible support for piping in all positions of travel must be provided, if destructive stresses and strains are to be avoided in today's high temperature piping systems.


PROBLEM
If Pipe Hanger "H" does not support full weight of piping "W" in both cold position "1" and hot position "2", dangerous stresses will result at connection "C".
H
W2
W1
C


SOLUTION
A Constant Support Hanger balances the weight of a vertically shifting load because a changing load moment is always balanced by an equal spring moment.
H
W2
W1

Heat 100 linear feet of alloy steel pipe to 1000° F, and it will expand 9.1 inches! When this thermal expansion takes place in a piping system, the resultant forces induced, if uncontrolled, can do incalculable harm.

Helical coil springs

The practice of using helical coil springs to allow this thermal expansion to occur is quite general. But the care that goes into the design or selection of flexible supports ofttimes is haphazard. In fact, many specifications covering the support of important high temperature piping will simply say "spring hangers shall be provided". Merely to contend that this may be dangerous is not enough.

Safety of entire system at stake

Unless careful study is given to the design and selection of spring supports which will maintain a balanced pipe system, the transfer of weight from one hanger to another, or from a hanger to a terminal point, will endanger the safety factor of the entire system.

With 8 . . . 9 . . . even 10 inches of thermal deflection not a bit uncommon today, completely flexible support for piping in all positions of travel is a positive "must".

The case for constant-support hangers

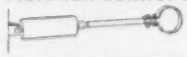
Where reactive forces at terminal points in a piping system must be kept within specified limits, constant support type hangers are recommended.

They are designed to provide uniform supporting force equal to the pipe load throughout the travel range and should be used at superheater outlets, turbine connections, and also on high temperature and other critical lines.

Variable spring hangers

When pipe lines are subject to vertical movement, and restrictive conditions do not require a constant-support type hanger, variable spring hangers are recommended. They should be designed to support not less than 85%, or more than 120%, of the design load throughout the total travel.

Vibration control and sway brace



When necessary to prevent abnormal movement or vibration in pipe lines, controls or sway braces of the energy-absorbing or instant-acting counter force type, are recommended. They dampen vibration, oppose pipe sway and absorb shock.

Hanger Engineering Service

The Pipe Suspension Department of Grinnell Company offers a design service to engineering firms which appreciate the specialized knowledge required to compute hanger loads and to select the proper supports for a balanced pipe suspension system when high pressures and high temperatures are involved.

Grinnell manufactures a complete line of pipe hangers and supports; maintains an experienced laboratory staff of technicians to discover better ways of solving pipe suspension problems; provides engineering assistance in design and installation; offers stocks of pipe hangers close to any job.

Hanger load calculation booklet

A 28-page booklet entitled "Hanger Load Calculations", compiled to furnish necessary data and procedure to determine pipe hanger loads, can be obtained from Grinnell Company. The tabulations of piping weights and thermal expansion have been arranged for convenient selection of data that otherwise consume considerable time to develop. It's yours without obligation.

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Kindly send me a complimentary copy of your "Hanger Load Calculations" booklet.

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Commander Mills, Inc., Sand Springs, Oklahoma

Chief Electrician, Wm. Bert Peacock, Speaking . . .

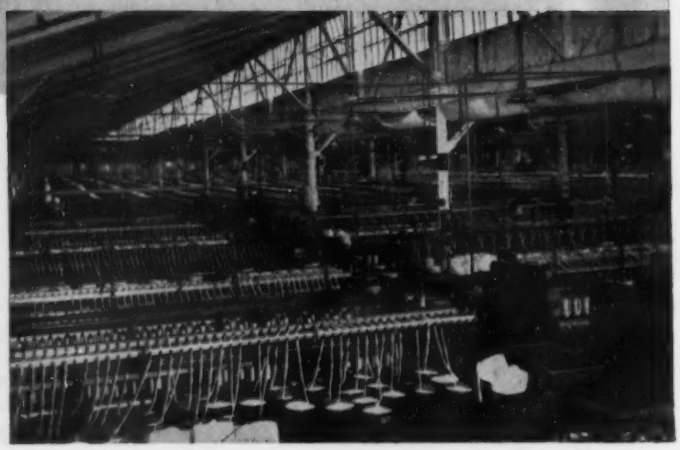
"Protecting motors with FUSETRON fuses is saving us about $6000.00 per year."

"We have a thousand looms, 90 of which are powered by 1 hp motors, 180 by 1½ hp, 100 by ½ hp, 630 by ¾ hp. Prior to 1949 several hundred of these were rewound each year. In fact, they carried them out by the truck loads to the motor rewind shop.

We started using Fusetron Fuses in the winter of 1949 and began to keep individual records on motors. The reduction on motor burn-outs was immediately noticeable. In 1950 only 44 loom motors were repaired.

There is no way to know how much damage was done to motors prior to our new system of maintenance, and it is my belief that some motor repairs now are due to partial damage done prior to 1949.

"In the entire plant we have over 2,500 motors, representing a little more than 5,000 hp connected load. The following list shows our actual expenses on motor repairs:"



"YEAR OF REPAIRS	NUMBER OF MOTORS	AMOUNT
1949	(No Record Kept)	$6,804.00
1950	87	2,796.20
1951	59	2,640.44
1952	63	2,165.63
1953 (1st 6 mos.)	23	445.84

	NUMBER OF MOTORS	DATE OF REPAIRS	AMOUNT
BREAKDOWN OF RECORD FOR MOTOR REPAIRS FOR PAST 6 MONTHS:	3	JAN.	$ 76.37
	4	FEB.	88.62
	3	MAR.	70.62
	4	APRIL	87.75
	4	MAY	101.86
	2	JUNE	20.62
			$445.84"

Commander Mills, Inc., Sand Springs, Okla.
Superintendent W. R. Swafford, *in charge of Manufacturing, says:*

"WE AVOID UNNECESSARY SHUTDOWNS AND PREVENT MOTOR BURNOUTS BY USING FUSETRON FUSES"

"In the sewing room we have 70 machines using ½ hp, 3-phase motors.

"They are all equipped with Fusetron fuses rated at 3.2 amperes. Formerly, we used 30 ampere fuses to avoid unnecessary blowing on the starting surges of the machines.

"The Electrical Department installed these smaller Fusetron fuses several years ago, and we have not had any trouble with blowing them needlessly and neither have we had any motor burnouts.

"We believe it better to blow a fuse than burn out a motor!"

FUSETRON is a trademark of the Bussmann Mfg. Co., Division of McGraw Electric Co.

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You too, can profit by the 10 POINT PROTECTION of FUSETRON dual-element FUSES

1*Protect against short-circuits.
2 Protect against needless blows caused by harmless overloads.
3 Protect against needless blows caused by excessive heating — lesser resistance results in much cooler operation.
4 Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5 Protect motors against burnout from overloading.
6 Protect motors against burnout due to single phasing.
7 Give DOUBLE burnout protection to large motors — without extra cost.
8 Make protection of small motors simple and inexpensive.
9 Protect against waste of space and money — permit use of proper size switches and panels.
10 Protect coils, transformers and solenoids against burnout.

*Fusetron Fuses have high interrupting capacity as shown by tests of the Electrical Testing Laboratories of New York City in December 1947.

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Please send me complete facts about FUSETRON dual-element Fuses.

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*Company*_____
*Address*_____
EW-2854
*City & Zone*_____ *State*_____ 154

Worker on Brooklyn Bridge is applying U.S. Holdtite Friction Tape over U.S. Uskorona splicing compound.

Splicing with "U. S." Tape on the Brooklyn Bridge

U. S. Uskorona and U. S. Holdtite® Tapes selected for new lighting system

Panoramic shot of Brooklyn Bridge's new lighting job.

With the remodeling of the main span and approaches of the Brooklyn Bridge by the New York City Department of Public Works, a new lighting system was installed. To insure that splices would have and would *retain* the same dielectric properties as the cables they covered, engineers selected U. S. Uskorona splicing compound, plus U. S. Holdtite Friction Tape. Uskorona is the best splicing compound made because it's the only one that protects against *both* ozone and moisture.

These United States Rubber Company products can easily withstand New York's severe extremes of weather conditions. For example, tests of four leading brands proved that Uskorona was the only one unharmed after 4 hours' exposure to ozone. Even when the exposure was extended to 500 consecutive hours, no damage occurred.

Naturally, these tapes splice easily, fuse quickly without heat or pressure. Electricians like the way the tape "handles". A staff of engineers is at every one of our 25 District Sales Offices to solve any industrial rubber problem. Or write to address below.

Applying Uskorona to a solderless connector on a tap off to the lighting installation.

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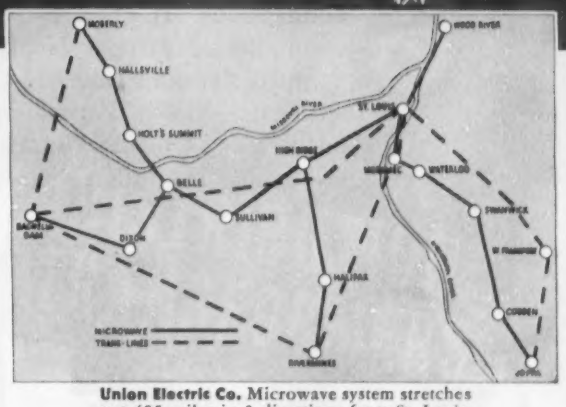
RCA Microwave radio relay installation at High Ridge, Mo. Towers are rugged, designed to withstand 100-mph winds under severe icing conditions.

Osage Hydroelectric Power Plant installation of Union Electric Company of Missouri, at Bagnell Dam, Mo.—serviced by RCA Microwave.



Union Electric Co. Microwave system stretches out 425 miles in 3 directions from St. Louis.

How UNION ELECTRIC solved today's communication problem

Two years ago Union Electric Company of Missouri ran into the communication problem which sooner or later confronts all growing utilities: their high-line carrier transmission system had become inadequate.

The 150 kc bandwidth, allotted for power line carrier operation, permits the use of only a relatively few channels which are not sufficient to meet all the requirements of a modern communications system. Direct wire lines were ruled out as too costly.

That prompted engineers to adopt Microwave, supplemented with mobile radio at major relay points. RCA Microwave provides channels for remote control of load dispatching, telemetering, teletype and voice communication. It results in close co-ordination of vehicles, field crews, executive and service personnel at outlying offices and stations. And, 70% of the RCA Microwave system is available for future expansion.

RCA Microwave can be interconnected with existing phone lines and switchboards. It uses familiar channeling circuits and readily available tubes. It provides as many channels as needed with minimum use of frequency space.

Now Union Electric has dependable, year-round communications over the full length of its operations. RCA "dish" antennas atop 100- to 300-foot towers, spaced 11 to 46 miles apart, send concentrated beams of radio energy from station to station. The radio beams follow a line-of-sight path—approximately parallel to the transmission lines.

You, too, can plan now for tomorrow's problems—prepare for your expanding communications needs before they develop. The booklet listed below provides quickly digested facts for future thinking, *with no obligation on your part.* Mail the coupon. *Remember,* only RCA can provide the nation-wide service facilities of the RCA Service Company.

RADIO CORPORATION of AMERICA
COMMUNICATIONS EQUIPMENT CAMDEN, N. J.

Dept. B45, Building 15-1

Please send me your reprint describing Union Electric Microwave system, *"Microwave Relines Overcrowded Circuits."*

Name_____ Title_____

Company_____ Address_____

City_____ Zone_____ State_____

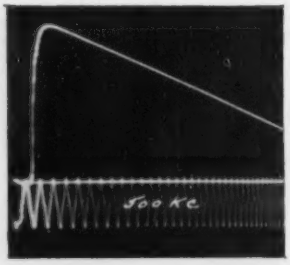
☐ Have an RCA representative get in touch with me.

Twist of Wrist
COMPLETES CONNECTION

TURN THE CLAMPING KNOB on Allis-Chalmers new high voltage sidewall bushing to complete installation connections. It grips two standard conductors as large as No. 2 stranded cable at the same time. It eliminates splicing. Make connections from either side of bushing quickly, without tools. Its design gives complete protection against live parts.

The new sidewall bushing is supplied on Allis-Chalmers distribution transformers 167 kva and smaller, 5 kv and below. Get complete facts from your nearby Allis-Chalmers authorized dealer or district office, or write Allis-Chalmers Manufacturing Company, Milwaukee 1, Wisconsin.

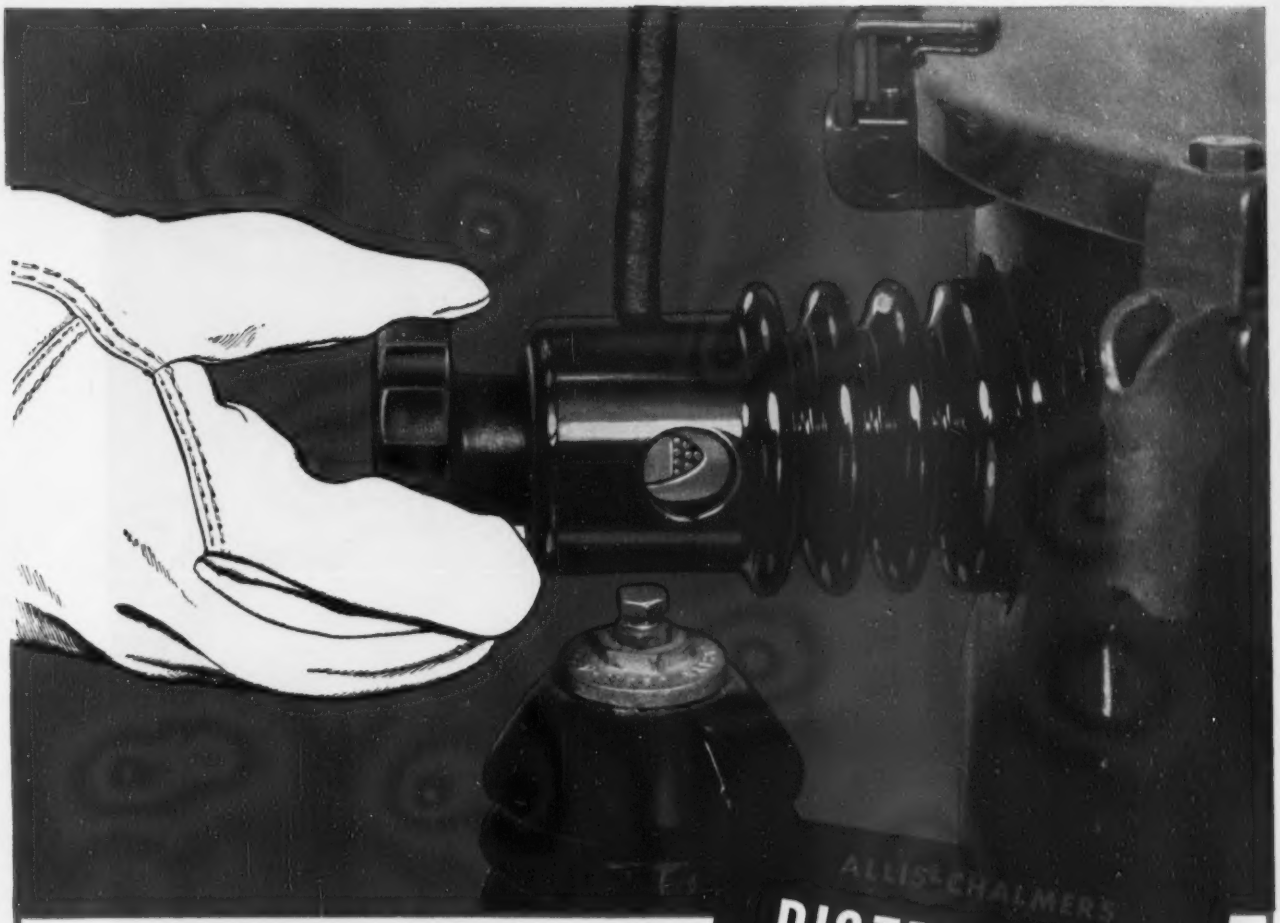
Proof of Performance for EVERY Standard Distribution Transformer



You know you get all the inherent insulation strength possible in an Allis-Chalmers distribution transformer. The oscillogram (right)—taken from a production line impulse test — proves it. It shows that all the production processes necessary to extend transformer life have been carried out. Not only distribution transformers with protective equipment, but conventional units are tested as well. This is Allis-Chalmers eighth year of production line impulse testing.

A-4213

ALLIS-



DISTRIBUTION TRANSFORMERS

FEATURES

1 Large molded phenolic clamping knob with finger-grips facilitates turning. It will not fall off, even when completely backed-off. Knob collar keeps fingers away from live parts.

2 Convex surfaced ram, actuated by knob, forces wires against the concave surface of connector body. This snubbing action locks the cable in the connector. All parts are tinned.

3 Integral bushing electrode simplifies lightning arrester installation on transformers. Gap from bushing to lightning arrester terminal removes electrical stress from the arrester except when flashover occurs.

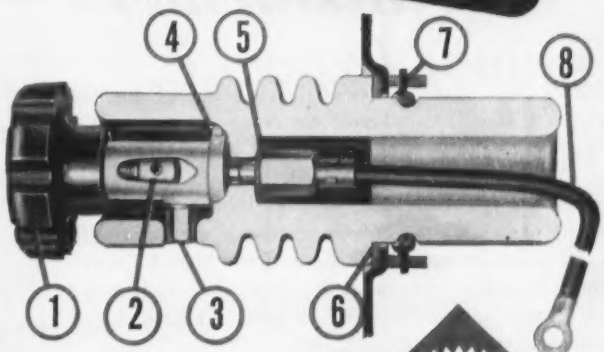
4 Connector is keyed to porcelain preventing rotation, thus protecting the gasket against twist or shear. Gasket prevents oil leakage.

5 Fibre gasket provides mechanical cushion between metal parts and porcelain.

6 Bushing is sealed in tank wall with corprene gasket. Recessed seat retains gasket for effective seal.

7 Internal clamping ring keeps bushing locked securely in place. Bolts exert even pressure on tank wall to produce uniform gasket compression. Internal ring helps simplify external maintenance.

8 Bushing cable terminates at terminal board. Easy removal simplifies routine maintenance.

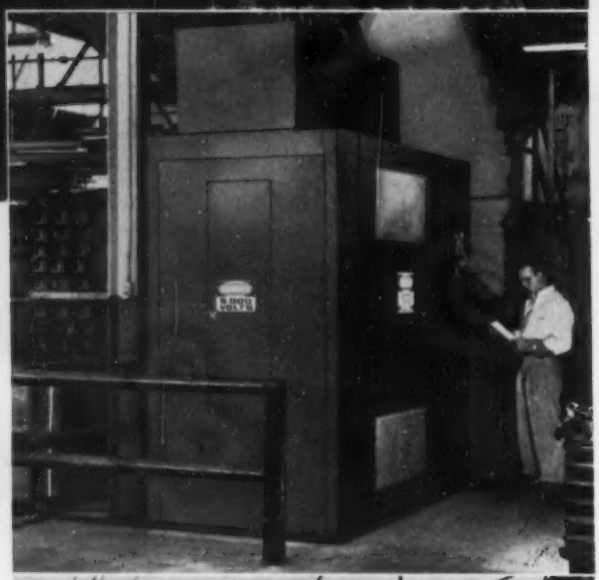


CHALMERS

A-C ALLIS-CHALMERS

POWER...

Above—one of the two 2,000 KVA unit sub-stations powered by an Uptegraff Dry Type Transformer, located near the assembly line.



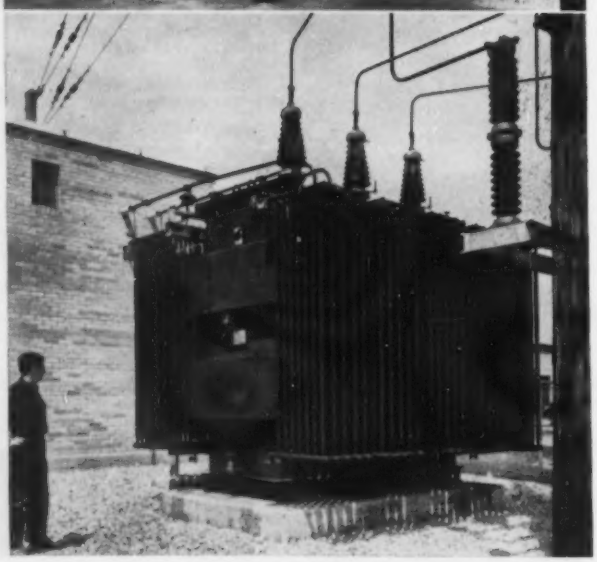
where and as needed . . .

with

UPTEGRAFF

transformers

Located close to the center of their electrical loads, the Uptegraff Dry Type Transformers shown here serve efficiently in the Newark, Ohio plant of the Ohio Gear and Axle Division of Timken-Detroit Axle Company. Line losses are reduced by the central location of the transformers, and power characteristics are improved. In this plant are two 2000 KVA and two 1000 KVA dry type Uptegraff Transformers. Supplying these indoor dry type Uptegraff transformers is a 6000 KVA oil-cooled Outdoor Power Transformer.

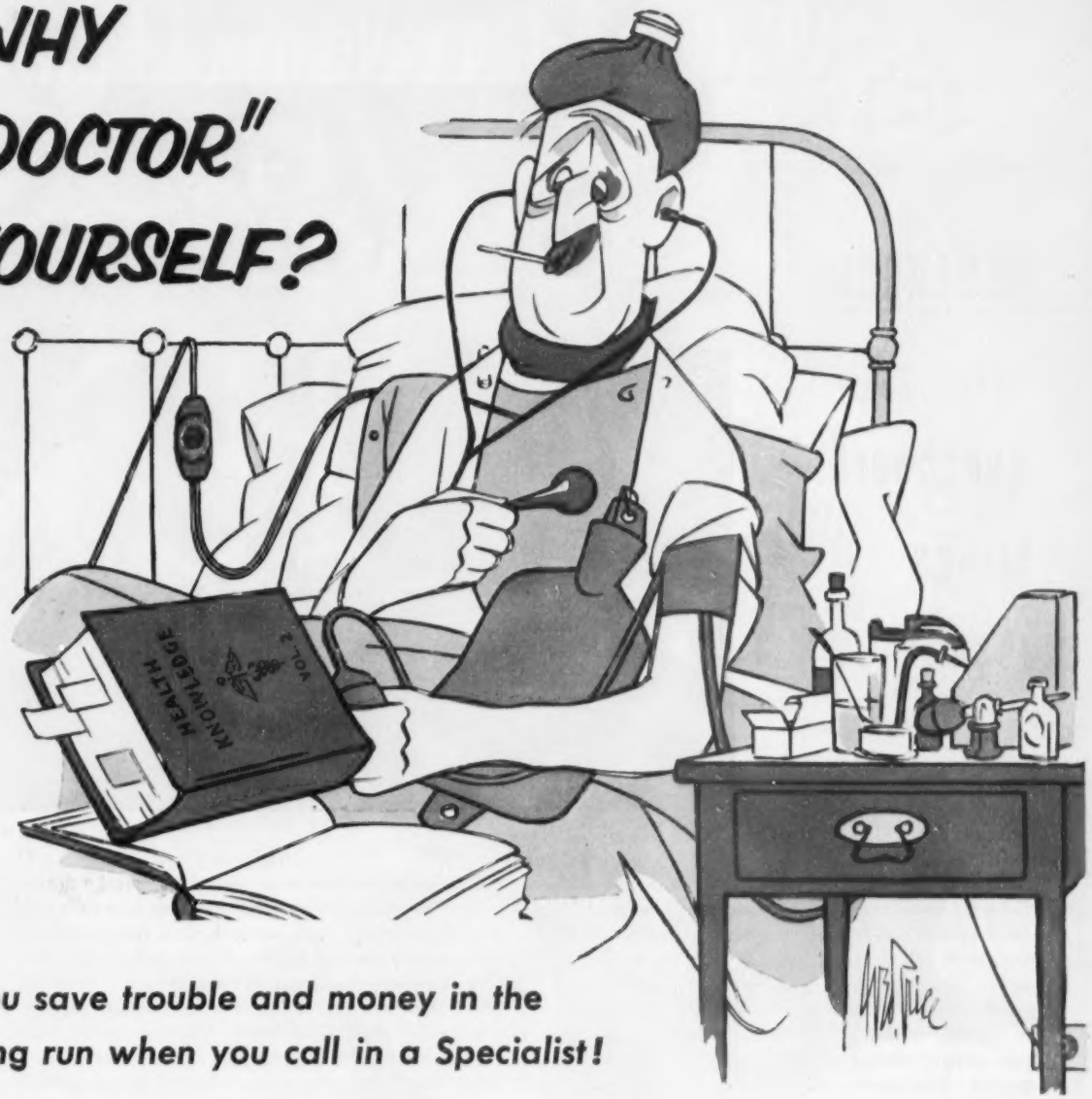


R. E. Uptegraff Manufacturing Co.

Scottdale, Pennsylvania

6000 KVA Uptegraff Outdoor Power Transformer supplying the entire plant is shown at the right.

WHY "DOCTOR" YOURSELF?



You save trouble and money in the long run when you call in a Specialist!

Prescribing lubricants for your complicated machines is, in a way, like prescribing medicine for yourself... a single mistake can be fatal. That's why it pays to call in a Specialist for consultation and advice when lubrication problems arise.

Socony-Vacuum has been serving industry for 88 years—far more than any other oil company. During this time we have built up a vast storehouse of lubrication knowledge and experience—have used this priceless information to develop top-quality oils and greases for every industrial need.

Working with you, we will apply this knowledge to diagnose your lubrication needs, prescribe the right oils and greases—install a program of Correct Lubrication. This cooperative effort will improve your production—reduce your maintenance costs.

Can you afford to accept anything less for your plant? Call your Socony-Vacuum representative.

Socony-Vacuum

SOCONY-VACUUM

Correct Lubrication

FIRST STEP IN CUTTING COSTS

SOCONY-VACUUM OIL COMPANY, INC., and Affiliates: MAGNOLIA PETROLEUM COMPANY, GENERAL PETROLEUM CORPORATION

Our long experience in working with both utilities and the public is your assurance of dependable work and good customer relations.

RESEARCH not guesswork brings results...

Bartlett clients have been amazed to learn how many different kinds of tree treatments and techniques are used by our dendricians. But when you think of the thousands of different insects, such as mites and scales, many of them invisible to the naked eye, which attack and destroy your shade trees, it is easy to see that successful results are dependent on accurate diagnosis and scientific controls. Research not guesswork brings results.

That's why we maintain the Bartlett Tree Research Laboratories at Stamford, Connecticut. In these laboratories and their 200 acres of experimental grounds, Bartlett scientists continuously study tree diseases and their proper treatment. The experience of these pathologists and entomologists is at the disposition of your local Bartlett representative which gives him the background and knowledge which untrained individuals could not possibly have.

For example, a client was perplexed by the discoloration of the leaves on one of his favorite shade trees. The local Bartlett representative was called in and found injury unknown to him. A specimen was immediately sent to our Tree Research Laboratories. Our scientists diagnosed the trouble and found an insect destructive to trees in other sections of the country but new to this area. A proper spray was recommended and feeding with Bartlett Green Tree Food. Today the tree is in a healthy, normal condition. Obviously, without the help of the laboratories, the trouble would not have been discovered and critical damage might have resulted. Efficient service like this is only possible when dendricians have the backing of knowledge and research.

It's no wonder those critical of results are turning to the Bartlett Way . . . the Scientific Way. You, too, can benefit by Bartlett service. Call your nearest local Bartlett office for a study of your tree situation.

You and your trees will be happy that you did.

BARTLETT TREE EXPERTS

The Bartlett Way

Home Office, Research Laboratory and Experimental Grounds, Stamford, Conn.

Local Offices from Maine to the Carolinas, and West to Indiana. See your Local Telephone Directory for Local Address.

Now! Complete Flexibility

THE NEW, IMPROVED *Wheeler* DURATACH LINE

Complete Interchangeability

New design permits use of any Duratach Reflector with any Duratach Canopy Assembly, thus easily adaptable to any installation.

3 methods of hanging

to meet all lighting requirements . . . basic PENDANT installation, with simple conversions to SIDE OUTLET and OUTLET BOX.

5 Reflectors

each designed to do a specific lighting job

RLM Standard Bowl

RLM 30° Angle RLM Deep Bowl

Shallow Dome Elliptical Angle

Wheeler **REFLECTOR COMPANY**

275 Congress Street, Boston 10, Mass.

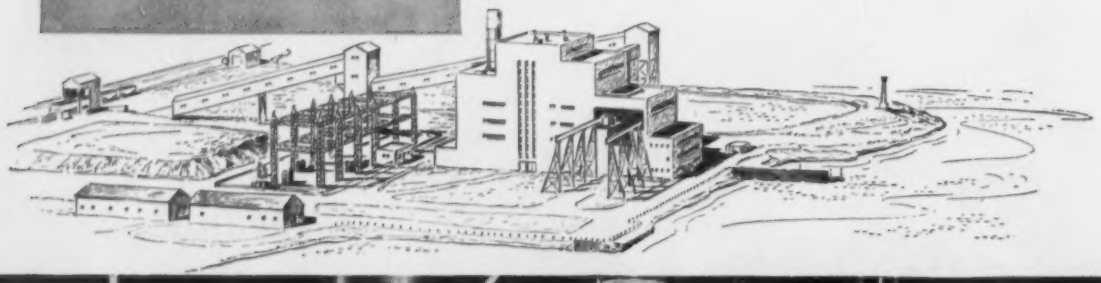
Distributed Exclusively through Electrical Wholesalers

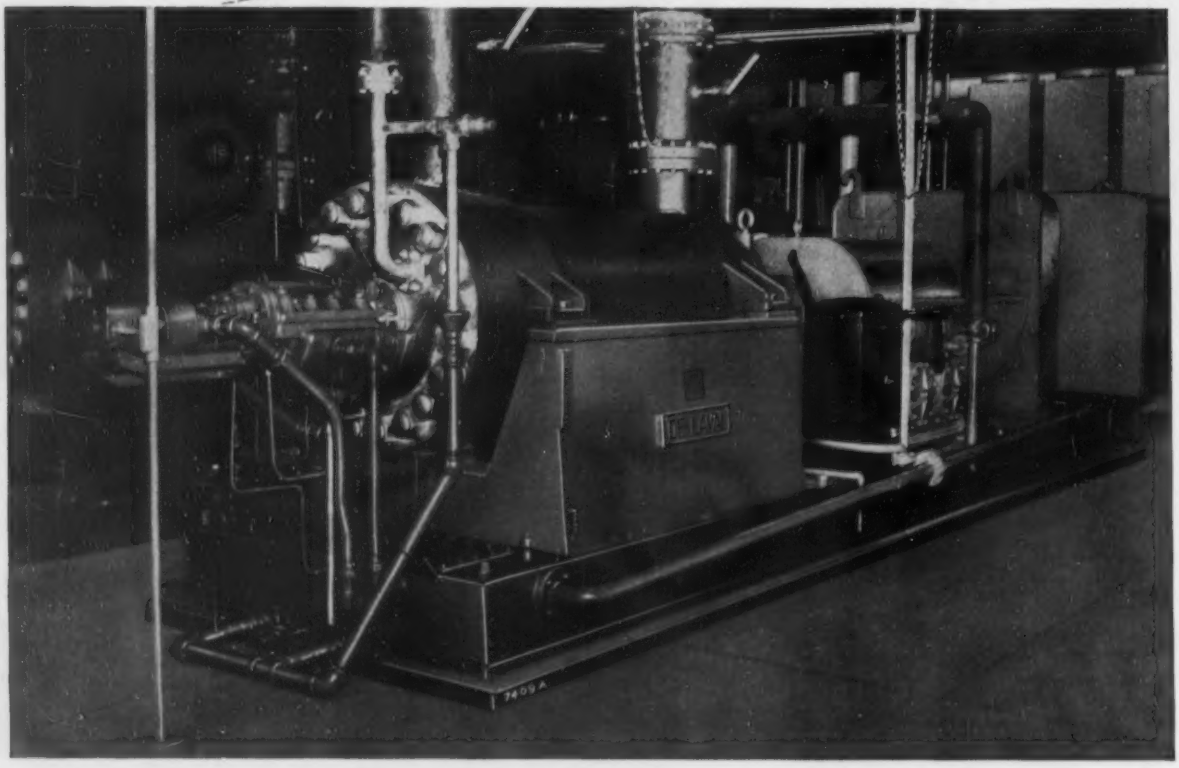
For complete information write for New DURATACH BULLETIN

DE LAVAL

BARREL TYPE
BOILER FEED PUMPS

on the job at Danskammer Point





These two De Laval 11-stage barrel type boiler feed pumps are now helping to produce power for the Danskammer Point Steam Station of the Central Hudson Gas and Electric Corporation. Both pumps, one of which is used for standby service, are sized for full boiler load and will deliver 1,400 gpm of 326F water against 2,155 psig discharge pressure. Two more same size De Laval pumps have already been ordered for the second main unit of the Danskammer Station.

De Laval barrel type boiler feed pumps meet all the requirements of high pressure boiler feed service. They can be thrown on the line quickly without long preliminary warming up. They are not affected by sudden temperature changes. The distinctive De Laval design assures years of reliable service with minimum maintenance.

DE LAVAL *Boiler Feed Pumps*

DE LAVAL STEAM TURBINE COMPANY
861 *Nottingham Way, Trenton 2, New Jersey*

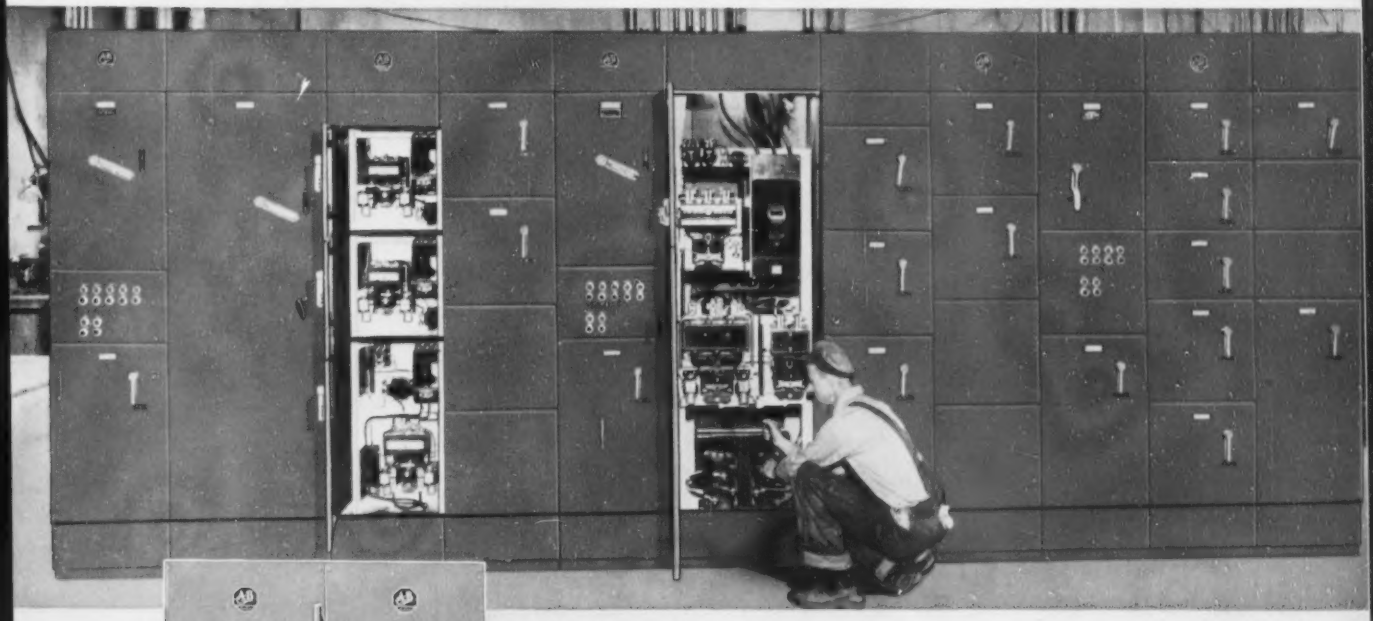
DL 179

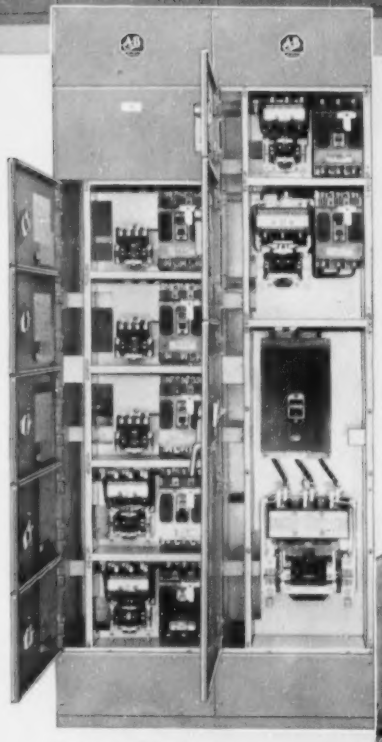
Don't Scatter Your Motor Starters
•
Use A-B Multi-Unit Control Centers

Group your motor starters together in Allen-Bradley Bulletin 798 Multi-Unit Control Centers and enjoy these five big benefits:

1—Centralized electrical maintenance
2—Increased safety to all personnel
3—Improved plant appearance
4—Reduced need for special starter enclosures
5—Greater flexibility in making plant changes

The whole story is told in Bulletin 798. Please write for copy.





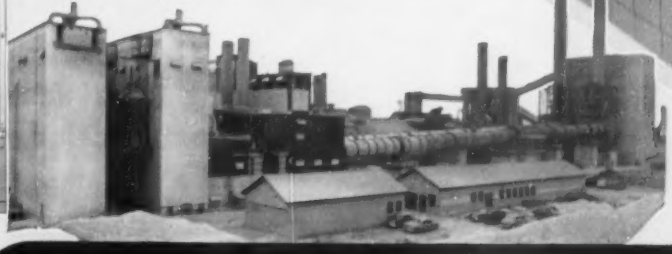
2-Section Allen-Bradley Control Center with Sizes 1, 2, 3, & 4 across-the-line starters . . . all with ITE circuit breakers.

Allen-Bradley Multi-Unit Control Centers Assure Continuous Production at Basic Refractories

In Maple Grove, Ohio, Basic Refractories, Inc., produces a large tonnage of refractory materials, using 390-foot, motor driven kilns with 200 hp fans. It is a continuous process and all motor controls are centralized in 8 large A-B Multi-Unit Control Centers, doing away with scattered controls requiring dust-tight enclosures.

Since Allen-Bradley double break, silver alloy contacts require no filing, cleaning, or dressing, the need for inspection is practically eliminated.

Allen-Bradley Co.
1316 S. Second St., Milwaukee 4, Wisconsin



8-Section A-B Control Center for grinding and screening controls.

A-B Quality

ALLEN-BRADLEY
BULLETIN 798 MULTI-UNIT CONTROLS
QUALITY

1-54-M

A 3-section, 8-unit, Allen-Bradley Multi-Unit Control Center operating a large electric furnace. One door open to show circuit breaker.

Bulletin 798
Multi-Unit Control Centers

NEATER • SAFER • INTERCHANGEABLE • ADAPTABLE

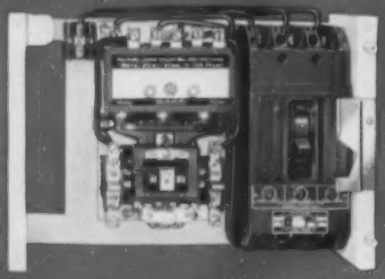
● There is a strong trend in modern plant layouts to concentrate motor controls in "control centers" like Allen-Bradley Bulletin 798 Multi-Unit Controls.

Bringing your motor controls together in one spot makes for more systematic inspection. It also prevents unauthorized changes in fuses, circuit breakers, and timing relay adjustments. It slicks up your plant and gives it a more modern, streamlined appearance. In fact, it often saves you the cost of providing special enclosures because control centers can be installed away from processes that are dusty, wet, or hazardous.

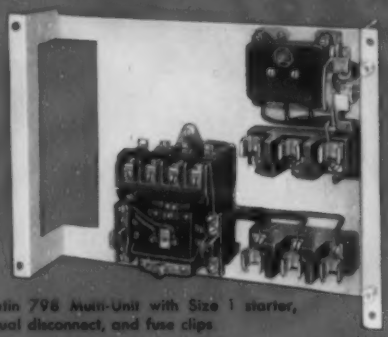
Let us send you an interesting, illustrated, 28-page booklet on Bulletin 798 Multi-Unit Controls. It shows the flexibility and adaptability of these versatile control units.

Allen-Bradley Co.

1316 South Second Street • Milwaukee 4, Wisconsin

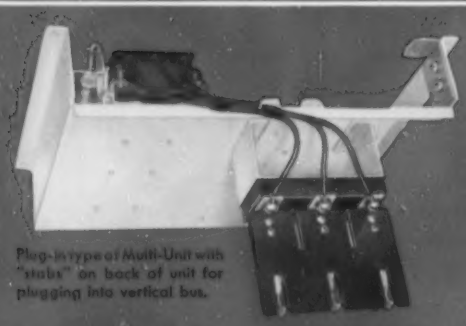


Bulletin 798 Multi-Unit with Size 3 solenoid starter and circuit breaker.



Bulletin 798 Multi-Unit with Size 1 starter, manual disconnect, and fuse clips

A-B Quality



Plug-in type of Multi-Unit with "stabs" on back of unit for plugging into vertical bus.

Fixed-connection type of Multi-Unit with permanently wired connection to bus.

Motor starters are removable as a unit, making it easy to adapt control center to changes in plant layout.

ALLEN-BRADLEY
BULLETIN 798
MULTI-UNIT CONTROLS
QUALITY

1-54-M

PRESENTS A SPECTACULAR ADVANCE

Thompson

IN

RIGHT-OF-WAY BRUSH CLEARANCE

BROAD SPECTRUM BRUSH KILLERS

Fortified with patented H. S. 31 to deliver extra creep for extra kill.

Thompson Broad Spectrum 2,4-D—2,4,5-T brush killers set a new standard for ease of application, more effective killing action and more economical results in brush clearance. Now your crews need no special technical skills—they simply mix and spray. Hard woods—all species—brush or weedy growth—powerful broad spectrum Thompson brush killers of controlled volatility remove the hazard of "chancey" effectiveness. Foliage spray or basal bark application, you get more kill per gallon and more gallons for your dollars.

Thompson Chemicals

Latest technical data free. Write for station paper No. 12

Thompson **CHEMICALS CORPORATION**

3028 Locust Street, St. Louis 3, Mo.
3600 Monon Street, Los Angeles 27, Calif.

representatives in principal cities

FIRST NAME IN BRUSH KILLERS

eye-insurance for Peninsular Life Insurance Company,

Jacksonville, Florida

Guth LITE-BLOX* TROFFERS

It's Peninsular Life's business to think of the future. And they have chosen Guth Troffers!

Just picture those inspiring lines of light in *any* office you plan or build. See how the troffers blend with the modern decor... how they appear to be custom-made for the setting. Notice how the even, low-brightness light softens every surface it strikes... even shiny steel files.

Guth Troffers fill the entire building with beauty and eye-ease. They create an atmosphere of efficiency... a pleasant place to work 8 full hours a day.

PACKED WITH ADVANTAGES

UNLIMITED LIGHT PATTERNS—They form any design that can be made with standard 12" ceiling tiles!

UNBROKEN LINES OF LIGHT—Precision-built units align perfectly in arrow-like lines.

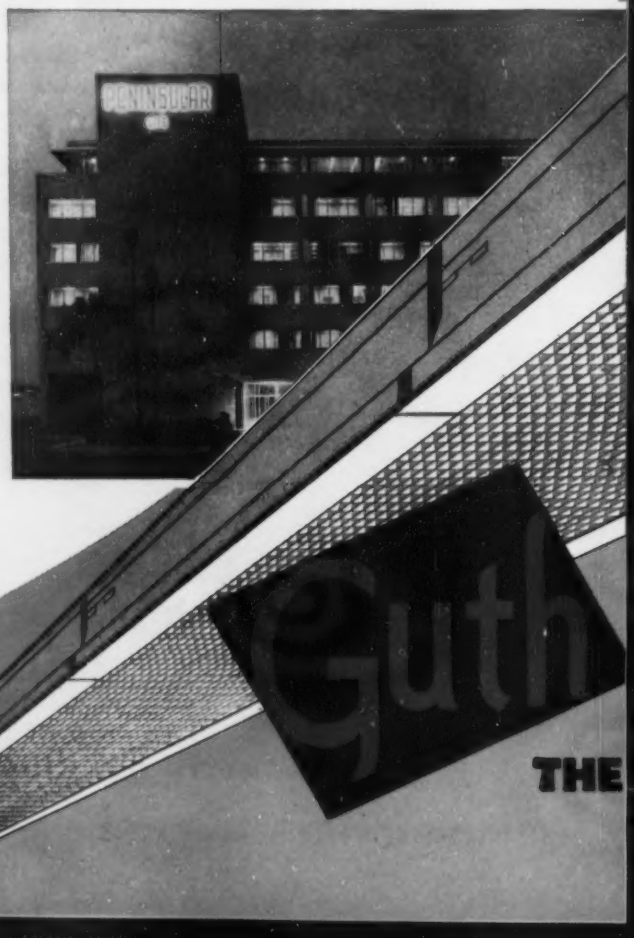
CUSTOM-MADE LOOK—Gleaming snap-on trim hides flange screws and "teebar gap"... adds a distinctive tailored appearance.

PERFECT CORNERS—Tile-Lites are used with troffers to make continuous light around corners.

THE EXACT FOOT-CANDLES YOU NEED—Use 1, 2, 3, or 4 lamps... 2', 4', 5', 6', or 8' lamps... choose from 24 different sizes of standard, slimline or low-brightness types.

EASIER INSTALLATION—Complete units... ready to mount. One man can hang them! Wide-open space for wiring. Modular lengths that fit the job: 2', 4', 5', 6', and 8'. No trimming!

LOW MAINTENANCE COST—Hinged shield frame for easy relamping or cleaning. Slide-in reflectors are simple to remove and replace—no latches or nuts. Ballasts may be replaced without taking troffer down.



May we send you our Catalog 869-H?
Just drop us a line on your letterhead.

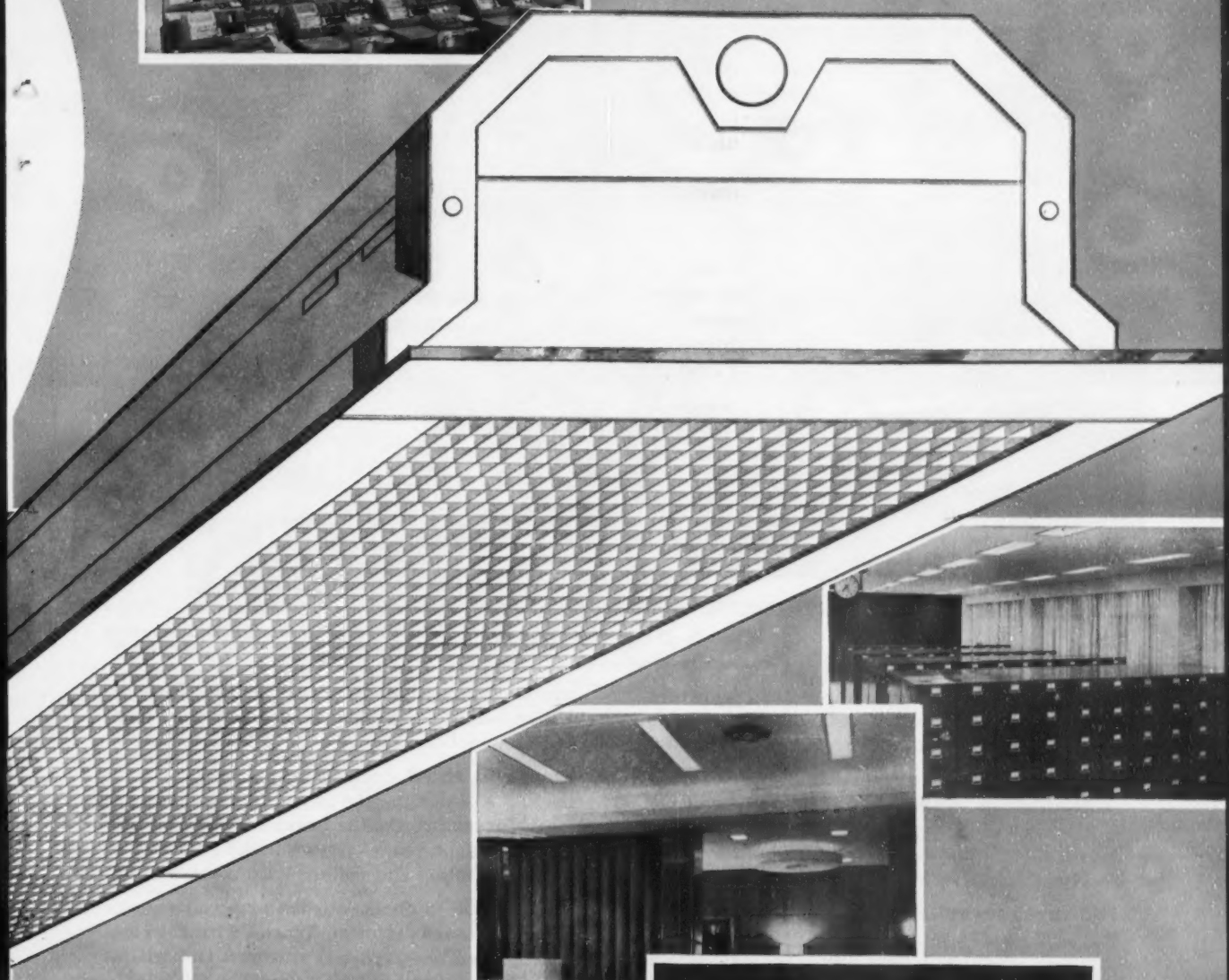
*TM—U. S. Pat. No. 2478822—others pending
**U. S. & Can. Pats. Pend.—TM Reg.

THE

ANY BOTTOM YOU CAN NAME

Select the type that goes with your motif:

- **GRATELITE****, *the new Louver-Diffuser for functional beauty and low-brightness, "velvetized" light (shown below)*
- PRISMATIC LENS
- GLOBOLITER
- CROSS BAFFLES
- ALBALITE GLASS
- CURVED PRISM LENS
- HINGED EGGCRATES
- OPEN TYPE
- FLUTEX GLASS



Installation Site:	Peninsular Life Insurance Co., Jacksonville, Fla.
Architects:	Kemp, Bunch & Jackson, Jacksonville, Fla.
Consulting Engineer:	R. M. Garth, Jacksonville, Fla.
Electrical Contractors:	Satchwell & Joseph Electrical Co., Jacksonville, Fla.
Electrical Distributor:	Leslie E. Porter, Porter Lighting, Inc., Jacksonville, Fla.

EDWIN F. GUTH COMPANY ST. LOUIS 3, MO.

Leaders in Lighting Since 1902

SEE HOW THIS
WORKSHOP ON WHEELS
SAVES TRIPS
SAVES MONEY

6 models with Service-Utility bodies. 77-inch body lengths for 115-inch wheelbase models, 89-inch lengths for 127-inch wheelbase models. GVW ratings, 4,200 to 6,500 lbs.

Here is one of the best ideas for reducing expenses that ever hit the service-trade and public utility fields ... INTERNATIONAL Trucks with Service-Utility bodies.

You save, first, with these advanced, efficient trucks because they speed up work. They have big capacity, locking compartments that provide space for tools, parts, and equipment, with built-in trays, shelves, and bins for orderly, convenient storage.

You save, second, because they take the workshop right to the job. Workmen have everything they need—right with them—on every service call. Vise brackets, pipe supports and ladder racks are available as optional equipment. With Service-Utility bodies you reduce mileage and wage costs caused by job-to-shop trips for needed items.

You save, third, because INTERNATIONAL engineering and design—the same as that which has made INTERNATIONAL the heavy-duty sales leader for 22 straight years—gives you long truck life, lowest operating and maintenance costs.

It will pay you to check into the many advantages afforded by INTERNATIONAL Trucks with Service-Utility bodies. Time payments arranged. Get full details from your INTERNATIONAL Dealer or Branch.

INTERNATIONAL HARVESTER COMPANY • CHICAGO

International Harvester Builds **McCORMICK®** Farm Equipment and **FARMALL®** Tractors ... Motor Trucks ... Industrial Power ... Refrigerators and Freezers.

→ Get the News! Alex Dreier "Man on the Go," daily NBC Radio, sponsored by INTERNATIONAL Truck Dealers.

INTERNATIONAL® TRUCKS
"Standard of the Highway"

Chassis of Tabet Photoelectric Control for street lighting, showing operating mechanism. **1**, photocell. **2**, amplifier tubes. **3**, filament transformer. **4**, power switching relay (underneath, not shown) which handles up to two 15,000 lumen lamps or a large number of auxiliary relays. **5**, pilot relay to control power switching relay. **6**, protective fuse.

Dependable Tabet Photocell Assures Positive Control of Street Lighting

The Tabet Photoelectric Control is a rugged, delayed-action relay that turns street lights on shortly after sunset and turns them off again shortly before sunrise. It provides positive assurance of having the lights go on when the foot candle level of daylight drops to a predetermined point.

A light-sensitive photocell and amplifier operate a power switching relay of high capacity and versatile design. Time delay mechanism prevents false operation that might be caused by momentary incidental light changes, such as lightning or passing car lights.

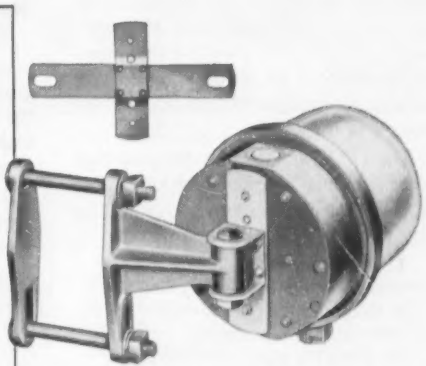
Sensitivity is variable from ½ to 6 foot candles. Standard setting turns the lights on about 20 minutes after sunset and turns them off about 20 minutes before sunrise. Operation at increasing light levels is delayed 10 seconds, and at decreasing levels 2 seconds, to prevent undesired operation.

Get Complete Information on Tabet Controls

Ask the L-M Field Engineer for details on the Tabet Photoelectric Control, or write Line Material Company, Street Lighting Div., Milwaukee 1, Wis., (a McGraw Electric Company Division).

Features of Tabet Controls

- Suitable for the control of either series or multiple systems.
- Positive Fail-Safe operation; if unit should fail, lights go on, or stay on.
- Tabet Model PR Photoelectric Controls are designed to operate pilot circuits either energized in daytime or energized at night. Thus series circuits, multiple circuits, or pilot wire normally energized or normally de-energized, can be controlled with one type photoelectric unit.
- Relay contacts rated at 3000 watts, handle two 15,000 lumen lamps or equivalent, or inrush currents up to 192 amperes.
- Highest quality ceramic and paper condensers.
- Delayed action; no false operation caused by transient light changes.
- Easy installation; entire unit plugs into weatherproof watt-hour meter socket.
- Simplified procurement and stocking; one control meets all requirements.

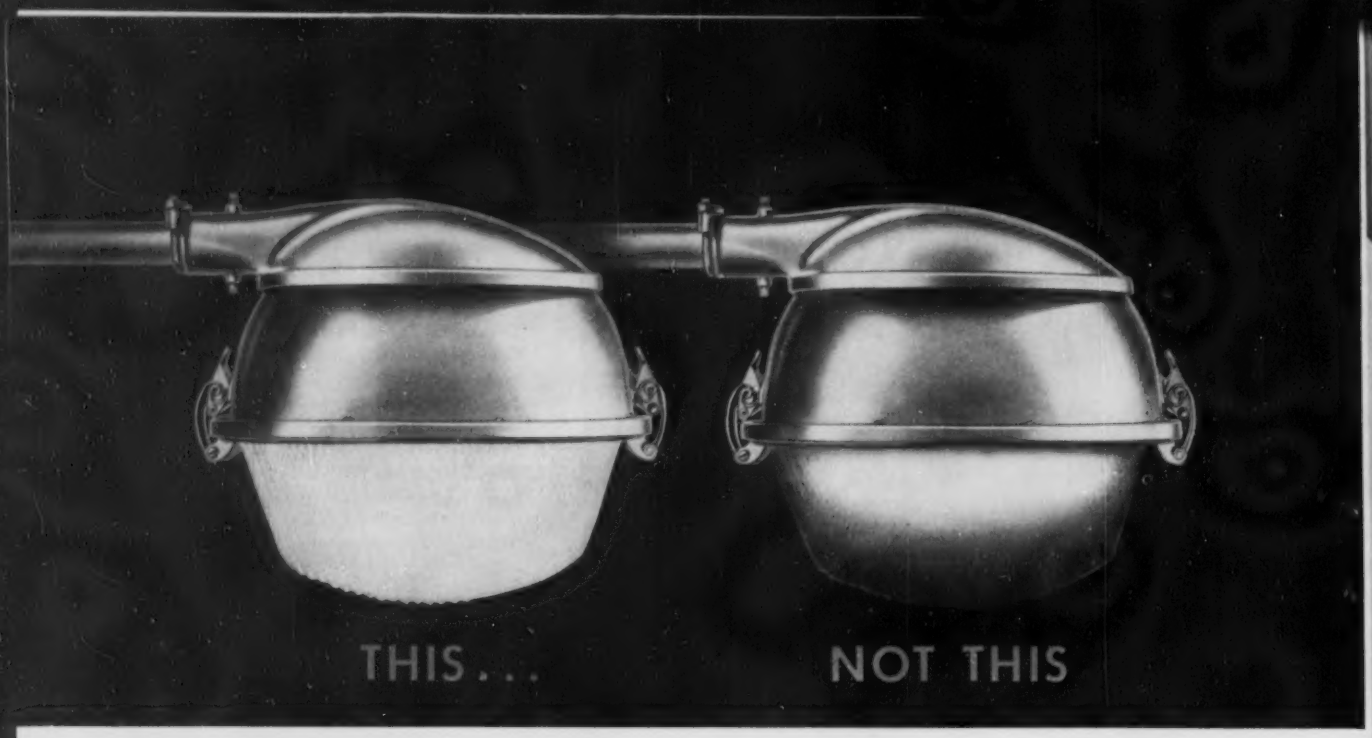


Mounting is simple. The meter socket may be mounted directly to the pole, or may be attached to the pole or crossarm by means of an inexpensive pole band. A swivel type bracket is also available for crossarm mounting, allowing orientation of the relay with the northern sky.

162

LINE MATERIAL

Street Lighting



L-M "Ovalite" Design Cuts Glare, Provides Uniform Light Distribution On The Street

The two major requirements for good high-intensity lighting in business and traffic areas are:

1. minimum glare from the light source;
2. uniform lighting on the street surface.

Seen against a dark background, every lighting unit has some glare. The problem is to reduce the glare to a minimum. Glare obscures the roadway and makes it difficult to see pedestrians or unlighted objects in the street.

The L-M Ovalite is so designed that glare is reduced, while at the same time light is distributed more evenly on the street surface. Here's how we do it:

The mercury vapor lamp is placed so that the light center is about 2½ inches above the bottom edge of the reflector. Thus, when you are driving down the street, you don't look directly at the lamp.

The reflector is so designed that it distributes the light evenly on the glassware, so that no one area receives a majority of the light.

Vertical prisms on the inside of the glass refractor raise the angle of the light emitted from the refractor, directing it to give uniform surface brightness on the glassware, and at the same time distributing it evenly over the street area.

The result, so far as glare is concerned, is seen by comparison of the two photographs at the top of the page. In the left-hand unit, the Ovalite, light is distributed evenly from all parts of the glassware. The right-hand unit, which does not have the same efficient optical system, has a hot spot along the top edge of the glassware, which causes glare and uneven light distribution.

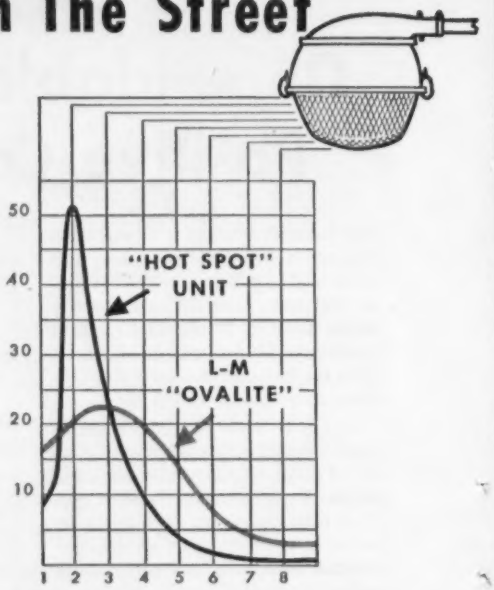
With its freedom from glare and its uniform distribution, the Ovalite gives greater safety and more efficient use of the light. Its optical system provides the wide distribution needed for business streets, shopping areas, and boulevards.

The Ovalite has many other good features—asbestos-covered internal wiring, strong construction, a double-hinge latch so you can swing the glassware down from either side. That makes servicing quick, easy, and safer.

Get The Whole Story

Ask the L-M Field Engineer for the "Ovalite" Bulletin—or write Line Material Co., Milwaukee 1, Wisconsin (a McGraw Electric Company Division).

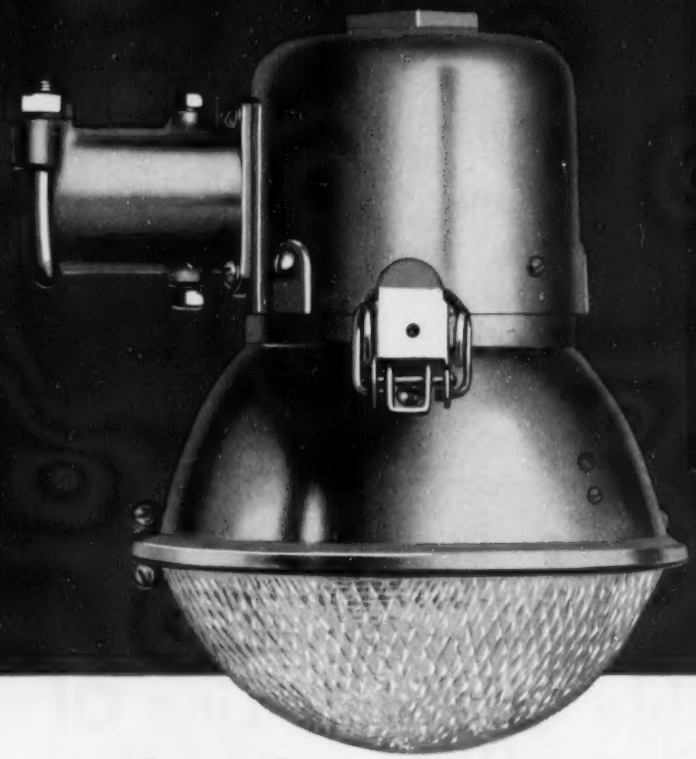
LINE MATERIAL
Street Lighting

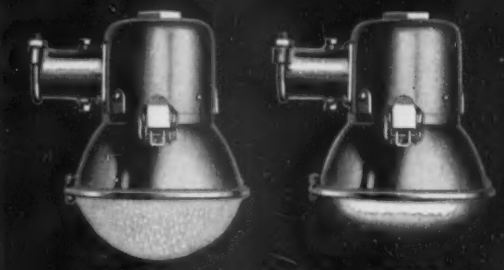


Tests Demonstrate Ovalite's* Uniform Brightness Distribution

To determine the relative brightness distribution of the "Ovalite" and a "hot spot" luminaire, measurements were made of the brightness of successive strips of the surface of each luminaire. Readings were taken in the main beam of both luminaires. The chart above shows that the brightness of the "Ovalite" is much more even, while the other luminaire peaks up, especially near the top of the glassware, which accounts for the hot spot seen in the right-hand picture at the top of the page. 121

*"*Ovalite*" *is a Line Material Company trademark.*





Spherolite Jr. Gives Good Lighting For Neighborhoods, Plus Interchangeability

L-M's Spherolite Jr. is a small, efficient luminaire for residential neighborhoods where narrow streets and wide light spacings prevail. It puts a high concentration of light in the main beam on the street, while shielding residential property.

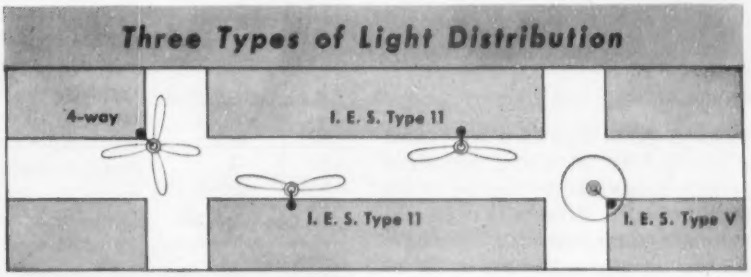
The unit is well designed and constructed to keep out dirt and moisture. Servicing is simple. Glassware may be removed by loosening the stainless steel V-Band holder, or reflector may be unlatched from the hood.

Complete Interchangeability

Spherolite Jr. fits both the 5000 volt Type A metal head and the wet process porcelain head. As traffic increases or the neighborhoods grows, the luminaire can be replaced with the larger standard Spherolite on the same heads. If you now have 600 volt multiple heads with radial bowls or open reflectors, you can replace these with the Spherolite Jr. without changing the heads.

Get Complete Information

Ask the L-M Field Engineer for details, or write Line Material Company, Milwaukee 1, Wisconsin (a McGraw Electric Company Division). 123



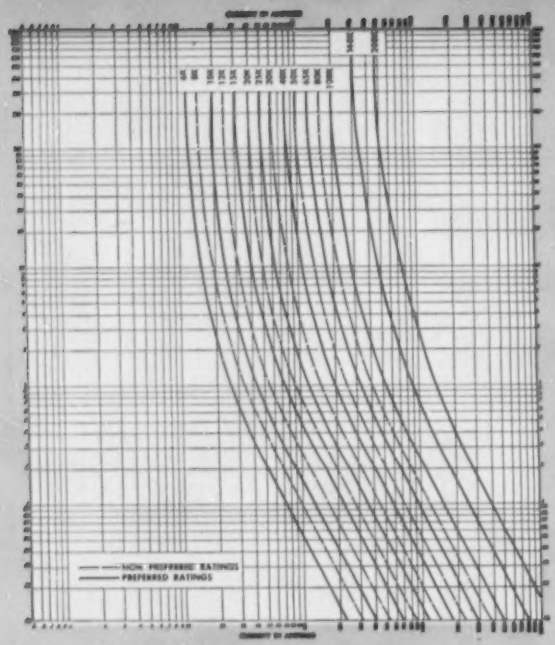
One reflector provides these three types of distribution, with three types of glassware. To change patterns you just loosen one screw in the V-Band holder and replace the glassware. It's quick and easy. No extra reflectors to stock.

Spherolite is a registered L-M trademark.

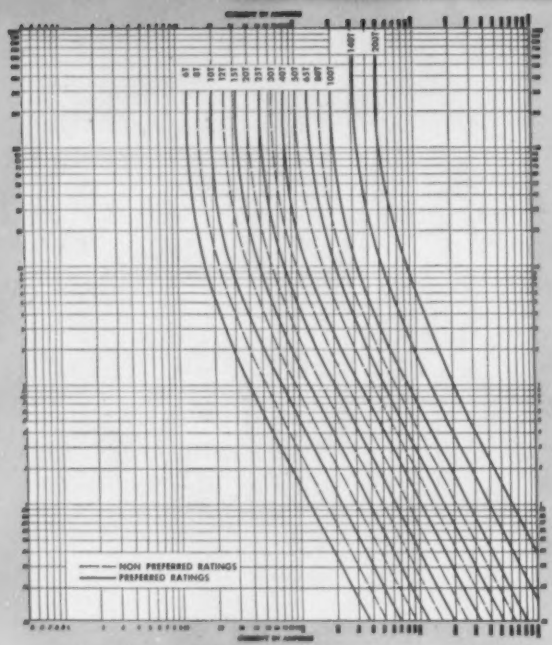
Spherolite Jr. with asymmetric patterns provides maximum beam at high vertical angles to compensate for wide spacings. The symmetric Type V is designed with lower beam angles for intersection or center parkway lighting. Details are given in Bulletin SL-2. Ask the L-M Field Engineer or write us for a copy.

LINE MATERIAL

LM® Street Lighting



"K" (fast) Links—minimum melting curves. Speed ratios vary from 6 to 8.1.



"T" (slow) Links—minimum melting curves. Speed ratios vary from 10 to 13.

Large size copies of these curves available from L-M on request

L-M Makes Available Complete Line Of New EEI-NEMA–Standard Fuse Links

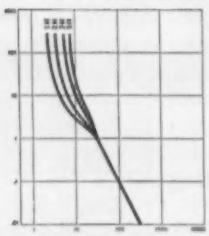
By R. D. Cleaves
Manager
Protective and Switching
Equipment Sales
Line Material Company

A joint project between users, represented by EEI, and manufacturers, represented by NEMA, has recently resulted in the establishment of definite time-current characteristics for fuse links. These have now been adopted as standard by the industry, in sizes covering all major operating requirements.

As a major fuse link manufacturer, Line Material Company has now made available a complete line of links meeting the new standards. L-M's new EEI-NEMA Fuse Links offer you these benefits:

1. **Industry-standard mechanical and electrical interchangeability, with assurance of uniform degrees of coordination between adjacent link sizes.**
2. **Two speeds—"K", fast, and "T", slow —with time-current characteristics to meet all major operating requirements.**
3. **Better coordination with reclosers covering a wider range of fault currents.**
4. **Simplified purchasing, stocking, and application.**
5. **Positive performance, precise electrical characteristics, and guaranteed quality.**

New L-M High Surge Links for sizes below 6 amperes



L-M High Surge Links —minimum melting curves

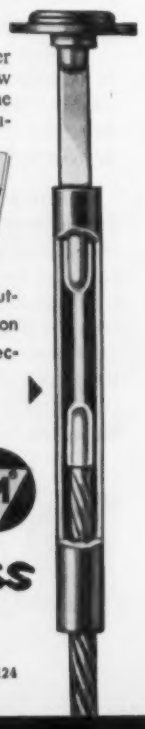
Today transformers are frequently worked up to their maximum thermal capacity. In protecting from overload, the protecting fuse link should remove the transformer from service whenever this capacity is exceeded. But it is important that the fuse link does not blow from surges and momentary overloads, causing needless outages and service trips.

Links large enough to stand these surges will not give adequate overload protection. Therefore L-M has provided a line of High Surge Links in 1, 2, 3, and 5 ampere sizes, which will stand the momentary inrush currents, and yet provide adequate protection.

These links have characteristics similar to 1, 2, 3, and 5 ampere N-rated links on the low current end, and 10 ampere N links on the high current end. These L-M High Surge Links allow good coordination with either the 10-"K" or 8-"T" EEI-NEMA links; and they supplement the EEI-NEMA-standard line.

Get Full Information

Ask the L-M Field Engineer for details and copy of new Bulletin FC5A. Or write Line Material Company, Milwaukee 1, Wisconsin (a McGraw Electric Company Division).



Rating clearly marked on button. One-piece forged button and shank. Horn fibre protective tube. Die-cast tin fusible section.

LINE MATERIAL

fuse cutouts and fuse links

It's Time to Roll Up Your Sleeve—Give Blood Now

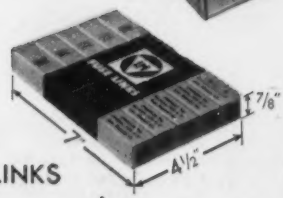
L-M's Outstanding Packaging System for EEI-NEMA Fuse Links

Provides sturdy protection for the links and convenience in warehousing, distribution, and handling.

1. (Left) **Tear Off Cell:** The perforated tape makes it easy to remove one link at a time from the 5-cell carton, without exposing other links.

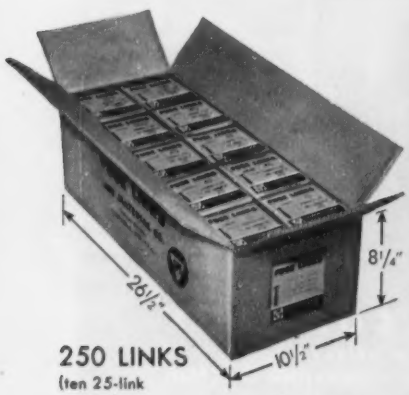
2. (Below) **Break Open:** The end of the cell is perforated. The link comes out of the cell in the lineman's hand. The complete job, from carton to cutout, can be done with gloved hands.

L-M's EEI-NEMA Fuse Links Conveniently Packaged



5 LINKS

25 LINKS
(five 5-cell cartons)



250 LINKS
(ten 25-link cartons)

Every cell, carton, and case is clearly marked with rating, and EEI-NEMA-Standard type (K or T). Rating and type are also clearly stamped on top of link button.

L-M provides an outstanding packaging system for its new EEI-NEMA-Standard and "N" rated fuse links.

Links are in individual 5-cell perforated containers (3-cell for links above 100 amperes). One cell at a time can be torn off and the link used without exposing other links.

Five of these 5-cell containers come in a 25-link carton. These, in turn, are packed 10 to a large 250-link case. All cases, cartons and cells are individually labeled, in large type, with quantity, rating, and link *type*.

This system provides for convenient shipping, storage, and distribution—in the warehouse and on the truck. Large cartons can be stored in the main warehouse. Branch warehouses can be supplied with the 25-link cartons. Five-cell containers can be carried in racks on the truck.

Convenient for storage in racks in line trucks. Ampere ratings shown in large type on both ends of cartons.

Free Handy Fuse Link Curve Sheet Packet and Bulletin on New EEI-NEMA Links

Ask the L-M Field Engineer for a copy of Bulletin FC5A, with full information on ratings and coordination of L-M's new EEI-NEMA-Standard fuse links. If you'd like it, he'll give you one of L-M's handy fuse link curve sheet packets with curves on EEI-NEMA and L-M Hi-Surge links. Or write Line Material Company, Milwaukee 1, Wisconsin (a McGraw Electric Company Division).

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LINE MATERIAL
fuse cutouts and fuse links

POWERS American AERIAL EQUIPMENT

AERIAL TOWERS

Series 7A-01 . . . in sizes for safe, smooth elevation to 21′ or 25′. Equipped with telescopic ladder. Operation from cab or tower. Platform revolves 360°.

HYDRAULIC AERIAL TOWERS

Series TW-2 . . . enables workmen to reach areas more than 35′ above ground. Can be operated from tower or truck cab. Platform revolves full 360°. Telescopic ladder is standard equipment.

REVOLVING Fully-Powered HYDRAULIC AERIAL LADDERS

Series HL-35 . . . elevates, extends, lowers, and retracts by *hydraulic power*. Available in sizes having ground-to-platform height up to 35′. Revolves full 360°.

REVOLVING AERIAL LADDERS

Series 5510 . . . perfectly balanced to permit fast, easy elevation. In sizes having 23′6″, 26′6″, and 30′6″ ground-to-platform height. Can be spotted at angles from 30° to 75°, and revolved full 360°.

HINGED LADDER RACK ASSEMBLIES

Standard and special racks, with extension ladders, can be furnished for installation on Powers-American bodies. These include racks with standard 24′ ladders, and racks with braced or trussed ladders to reach heights up to 30′.

A descriptive bulletin is available on each item of aerial equipment in the Powers-American line. Bulletins, plus prices and complete details, are yours for the asking.

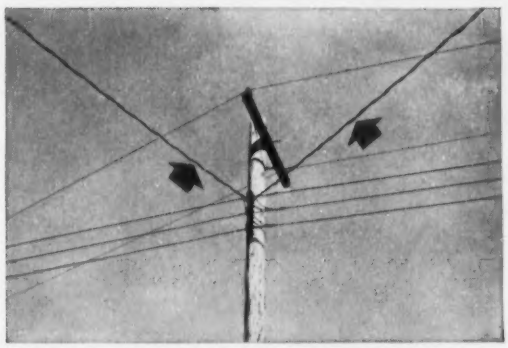
McCABE-POWERS AUTO BODY COMPANY

MAIN OFFICE
5900 NO. BROADWAY • ST. LOUIS 15, MO.

WESTERN OFFICE
428 LATHAM SQ. BLDG. • OAKLAND 12, CALIF.

Rugged neoprene covering

adds extra service life to triplex cable



Years of sunlight and weathering won't crack or deteriorate sturdy neoprene covering.

With tough neoprene covering, residential installations are neat and clean-looking. No braids to rot or festoon.

Triplex self-supporting secondary and service drop cable with neoprene covering provides outstanding durability and protection. In residential areas the neoprene cover resists sunlight and weathering. There are no braids to rot or festoon. In industrial sections, neoprene protects against corroding smoke, fumes, and gases . . . gives years of dependable service.

Triplex cable is just one of the many uses of neoprene-covered cable. Wherever you use cable . . . above ground . . . in ducts . . . or directly in earth—it pays to specify cable covering of Du Pont neoprene. It's available in single- or multiple-conductor types and in voltage ratings to meet your requirements. For further information, consult your supplier.

FREE! The Neoprene Notebook

Each issue contains interesting applications of neoprene . . . new products . . . on-the-job reports. Send in the coupon below to get on the mailing list.

NEOPRENE

The rubber made by Du Pont since 1932

DUPONT

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

E. I. du Pont de Nemours & Co. (Inc.)
Rubber Chemicals Division EW-2, Wilmington 98, Del.
Please put me on the mailing list for the Neoprene Notebook.

*Name*_____ *Position*_____

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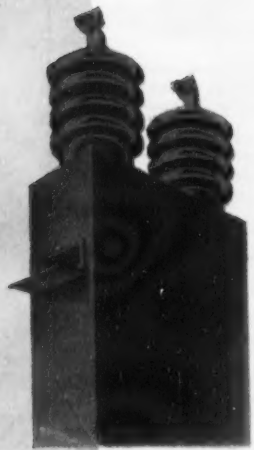
C-D best by
FIELD

In seacoast distributing systems, where electrical components are subjected to severe arcing and leakage conditions, C-D capacitors have, year after year, demonstrated their superiority. That is why, today we can point to specific C-D coastwise installations that have come through 10 and 15 years of service such as this – *with little or no maintenance required.*

TEST



Not only has Cornell-Dubilier's conservative bushing design and major insulation level provided trouble-free shunt corrective service, but also afforded a substantial measure of system surge protection. This C-D policy of building an extra margin of safety into every C-D capacitor is reflected in lower volts per mil unit stress; and an ability to withstand high transient surge conditions. The wisdom of this policy is confirmed by the unmatched field performance records of over 4,000 C-D installations.

One of our engineers will be glad to "name names" and show you the field performance records on actual C-D installations. Write to: Cornell-Dubilier Electric Corp., Dept. D-24, South Plainfield, New Jersey.

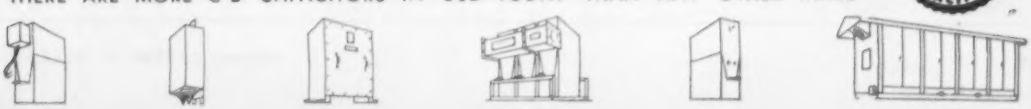
ONSISTENTLY EPENDABLE

CORNELL-DUBILIER CAPACITORS

FOR POWER-FACTOR IMPROVEMENT

PLANTS IN SOUTH PLAINFIELD, N. J.; NEW BEDFORD, WORCESTER AND CAMBRIDGE, MASS.; PROVIDENCE AND HOPE VALLEY, R. I.; INDIANAPOLIS, IND.; SANFORD AND FUQUAY SPRINGS, N. C.; SUBSIDIARY: THE RADIART CORPORATION, CLEVELAND, O.

THERE ARE MORE C-D CAPACITORS IN USE TODAY THAN ANY OTHER MAKE



ELECTRICAL INSULATION IS OUR SPECIALTY

Q. *What ONE wire and cable producer grows its own natural rubber, and makes its own synthetic rubber?*

A. UNITED STATES RUBBER COMPANY.

Q. *What ONE wire and cable producer makes plastics?*

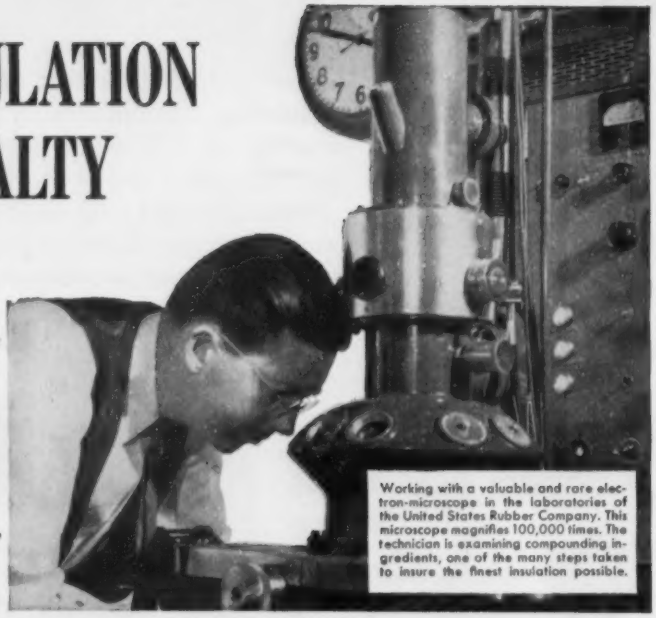
A. "U. S."

Q. *What is the most important part of wire and cable?*

A. The insulation.

Q. *Who is best equipped to make wire and cable with superior insulation?*

A. U. S. RUBBER—which grows its own natural rubber, makes its own synthetic rubber, manufactures its own plastics.



Working with a valuable and rare electron-microscope in the laboratories of the United States Rubber Company. This microscope magnifies 100,000 times. The technician is examining compounding ingredients, one of the many steps taken to insure the finest insulation possible.

Isn't it logical that a rubber company should make the best wire and cable insulation there is? U. S. Rubber has been a pioneer in insulation for over 70 years—has amassed in that time a stockpile of research data and experience that can't be beat. Electrical insulation is a "U. S." specialty!

Electrical insulation makes the difference between superior and ordinary wire and cable. Conductors of all manufacturers are standard, but insulation must be the best that science can produce. That's why your best bet in wire and cable is U. S. Rubber.

SOME MORE OF THE MANY DIFFERENT VARIETIES OF "U. S." WIRE AND CABLE

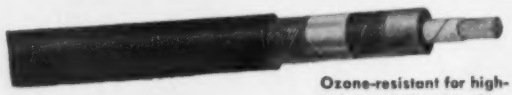
UTILITIES: Power Cables • Street Lighting • Royal Cords • Network Cables • Utility Control • Pole & Bracket Cable • Service Entrance • Weatherproof • Zip Cord Pole Fixture Cable • Sup. Control

RAILROADS: Power Cables • Communications • Railway Signal • Royal Cords • Welding Cable • Railway Utility • Sup. Control • Weatherproof

HEAVY INDUSTRY: Power Cable • Royal Cords • Welding Cables • Control Cables • Machine Tool Wire • Building Wire • Switchboard Wire • Thermostat Cable • Bus Drop Cable

ONE OF MANY SUPERIOR "U. S." WIRE AND CABLE PRODUCTS

USKORONA-NEOPRENE POWER CABLES



Ozone-resistant for high-voltage applications in wet or dry locations.

These cables are for use on power distribution, street lighting and station control circuits and for general-purpose wiring on circuits up to 8000 volts between phases and at conductor temperatures up to 75 C. They will not crack after 3 hours in air containing .015 per cent ozone. They are light in weight, easy to install and join, and are resistant to oil, heat, sunlight, flame, acids, alkalis and corrosive chemicals. Uskorona-Neoprene cable also eliminates electrolysis. The following are guaranteed test values:

PHYSICAL AND AGING PROPERTIES (MINIMUM VALUES)

	Uskorona			Neoprene Jacket	
	Unaged	After 96 Hrs. O.B.	After 7 Day Geer Oven	Unaged	After 96 Hrs. O.B.
Tensile Lbs./Sq. In.	500	450	450	1800	1600
Elongation Per Cent	250	200	200	300	250

MOISTURE RESISTANCE (MAXIMUM VALUES)

Dielectric Constant and Power Factor of the insulation after immersion in water at 50 C.: Dielectric Constant, one day is 4.5; per cent gain, 1 to 14 days is 5.0; per cent gain, 7 to 14 days is 2.0; Power Factor, per cent, one day is 3.0; Stability Factor 40-80 volts/mil two weeks, per cent is .5.

U.S.RUBBER
SERVING THROUGH SCIENCE

UNITED STATES RUBBER COMPANY

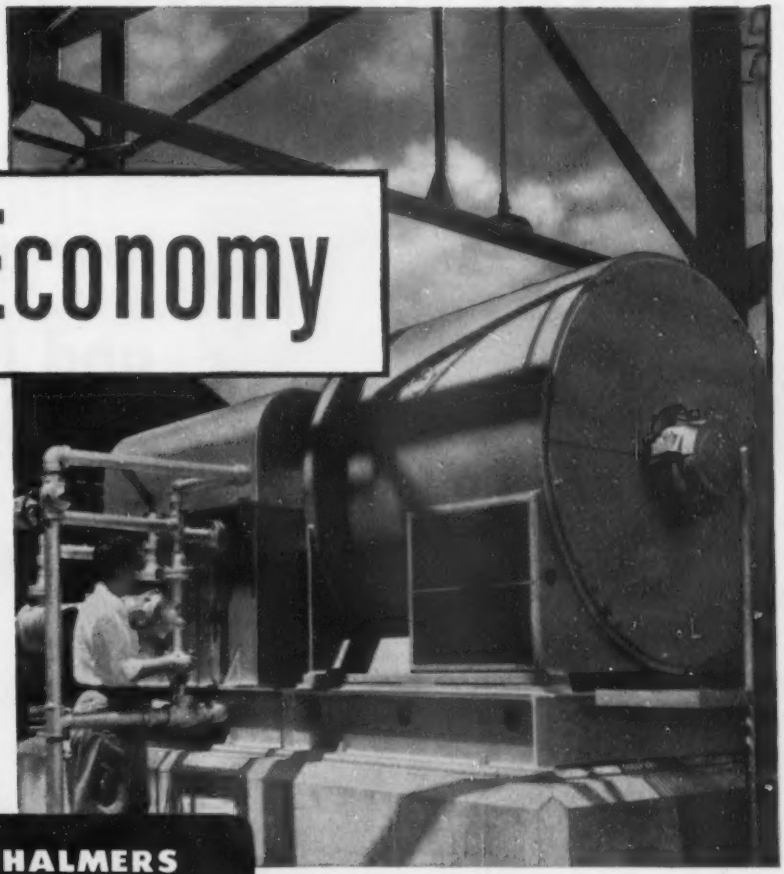
ELECTRICAL WIRE & CABLE DEPT. • ROCKEFELLER CENTER, NEW YORK 20, N. Y.

3-Way Economy

OPEN SKY is all the roof they need

MAINTENANCE is cut to the minimum

RELIABILITY assures maximum availability



ALLIS-CHALMERS

TEFC MOTORS

Induced-draft fan motor for A-C turbine-generator equipped installation at Georgia Power's Plant McManus is rated 900 hp, 2300 volts, 705 rpm.

WITH Allis-Chalmers *tube-type* totally-enclosed fan-cooled motors, you can cut auxiliary drive costs three ways. The opportunity for low installation cost through outdoor applications is only the beginning. Low maintenance and peak reliability both pay worth-while dividends throughout the long life of these motors.

These savings can be yours because the *tube-type* air-to-air heat exchanger design of Allis-Chalmers TEFC motors offers these advantages:

Complete enclosure protects stator core and other electrical parts from dirt and corrosion — indoors or out — under the most severe ambient conditions.

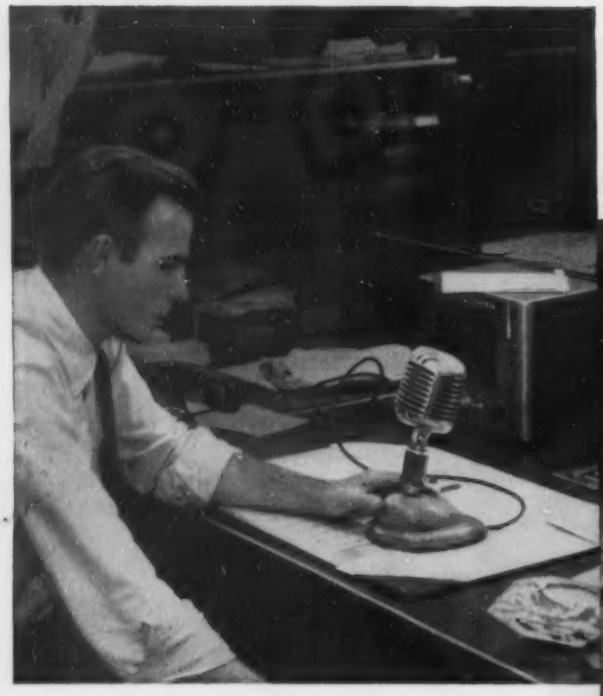
Self-cleaning action results from generous flow of outside air through smooth, straight, heat-exchanger cooling tubes.

Full internal air circulation provides efficient, even cooling for long, trouble-free insulation life . . . and makes large ratings practical.

Available in sizes from 40 hp at 600 rpm to the largest required for power plant auxiliaries, this motor design has been proved in operation by hundreds of installations since 1946. For more information ask your A-C representative for Bulletins 51B7149 and 05B7150, or write to Allis-Chalmers, Milwaukee 1, Wisconsin. A-4258

ALLIS-CHALMERS

"13 YEARS' EXPERIENCE PROVES G-E BEST ON ALL COUNTS . . . performance, low maintenance and long life!"



▲ **VITAL DISPATCHING FUNCTION** that ties all service requirements into the radio network is handled at this office. Here, Jack Haley issues instructions which are acted on seconds later by maintenance crews.

FULL TIME UTILIZATION of 21 1st class troublemen and 12 trouble trucks is realized by I. P. & L. Co. Instant contact with Dave Pierson, at right, puts him "on-the-job" quickly. A total of 71 G-E radio equipped vehicles can be called into service for extreme emergencies. ▶

2-WAY MOBILE RADIO

"Our complete satisfaction," says Indianapolis Power and Light Company, "is borne out by the fact that we continue to purchase G-E 2-way equipment ever since the original investment in radio was made." Since 1940 this G-E communication system has grown from 10 mobile units and one base station to 71 mobile plus 2 portable units. Wide use of these facilities enables I. P. & L. Co. to speed up all operations . . . save hundreds of man hours . . . and most important . . . to improve service in an area covering 528 square miles!

● Has your company's communications kept pace with the need for expanding utility service? Let General Electric help you answer this question. Call our local office today or write: *General Electric Company, Section X1924, Electronics Park, Syracuse, New York.*

Follow the trend . . . Replace with G-E!

GENERAL ELECTRIC

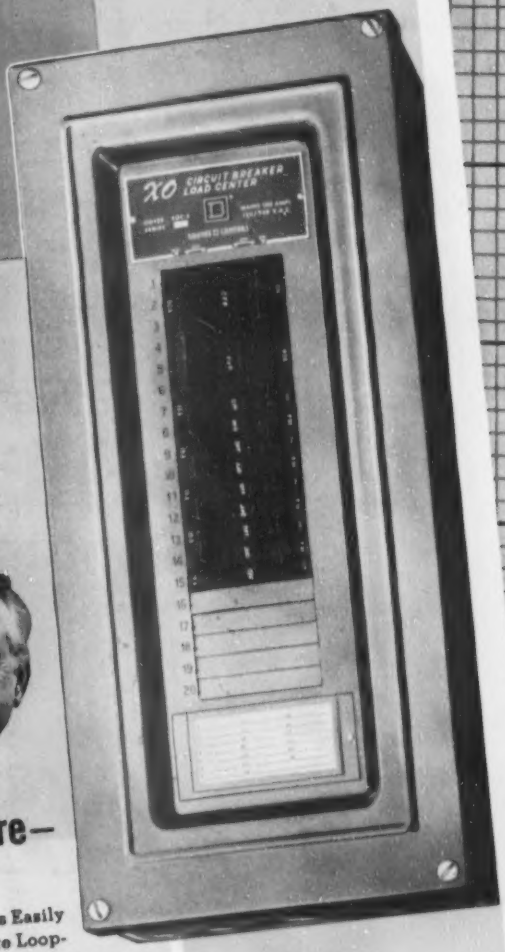
MAKE THE JOB EASIER with XO CIRCUIT BREAKERS

You'll find that XO breakers are EASIER TO SELECT!

I'm sold on XO breakers because they're EASIER TO BUY!

Know why I like 'em? Because they're EASIER TO INSTALL!

I give the nod to XO breakers because they're EASIER TO LIVE WITH!



Here's why XO Breakers are—

EASIER TO SELECT!
Wide Range of Devices, 1 to 32 Circuits • Main Breakers or Main Lugs • 1 Phase 3 Wire or 3 Phase 4 Wire • Available in either General Purpose or Raintight Enclosures

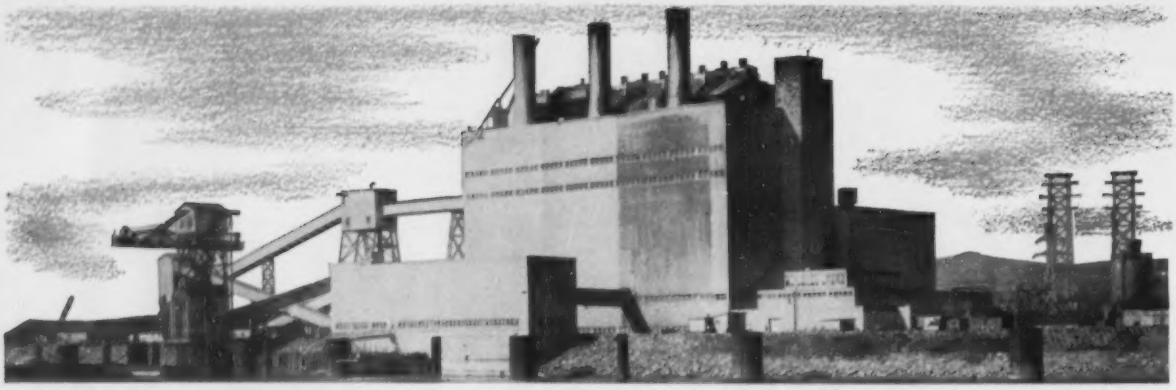
EASIER TO BUY!
Off-the-Shelf Delivery from Distributor's Stock • Only 3 Basic Components: Box-Interior, Breakers, and Cover • Simplified Packaging

EASIER TO INSTALL!
PLUG-IN BREAKERS: Load Lugs Easily Accessible from Front • No Wire Looping • ENCLOSURES: Matching Knockouts • Plenty of Wiring Space • Adjustable Interiors

EASIER TO LIVE WITH!
Attractive Appearance • Rugged Breaker Design • Positive Operation • Long Life • Ambient Compensated • Non-Interchangeable Units discourage tampering

ASK YOUR ELECTRICAL DISTRIBUTOR FOR SQUARE D PRODUCTS

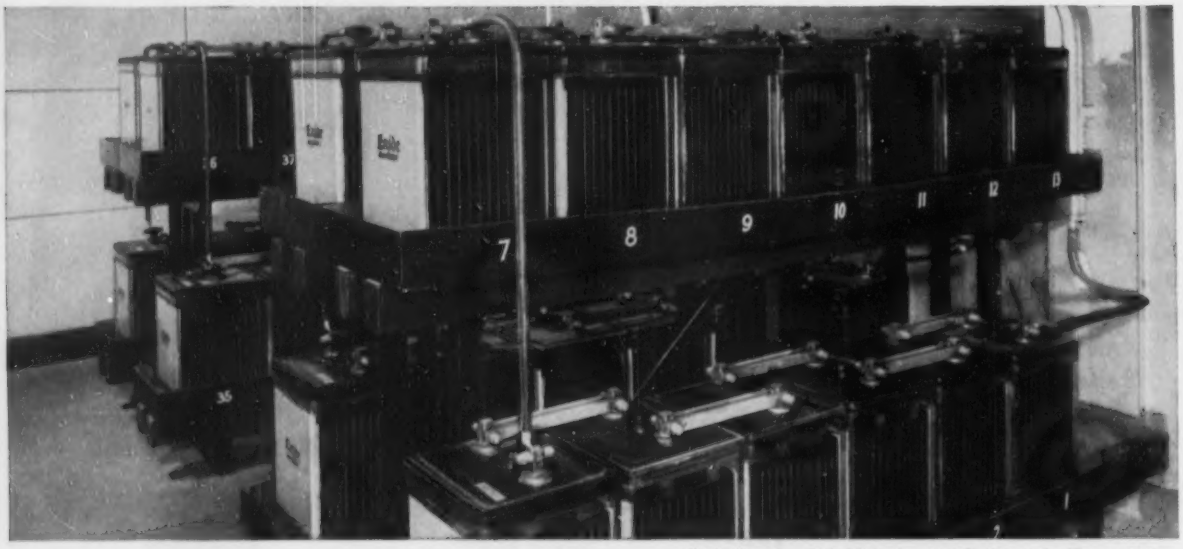
SQUARE D COMPANY



Modern, efficient and packed with power—the Elrama plant of Duquesne Light Company.

Pacing Industrial Progress—*Duquesne Light Company*

Exide-Manchex BATTERIES



Exide-Manchex FME-25 battery installation at the Elrama station.

Although Pittsburgh's electricity needs will continue to grow, Duquesne Light Company's newest power station will be a vital factor in meeting today's as well as future demands for electrical power. The Elrama plant, located on the Monongahela River, is the fifth in the Duquesne system. It has two 95,000-kilowatt units now in operation, with a third unit of 120,000-kilowatt capacity scheduled for completion in 1954. Duquesne Light Company's present expansion program will have added 91 per cent as much generating capacity as was installed in the 70 previous years of the company's history.

It is significant that Duquesne employs Exide-Manchex batteries; they assure:

POSITIVE OPERATION: Dependable performance at ample voltage avoids switchgear operational failures.

INSTANTANEOUS POWER: High rates for switchgear and valve operation with adequate reserve power for all other control circuits and for emergency lighting.

LOW OPERATING COST: Extremely low internal resistance.

LOW MAINTENANCE COSTS: Water required about twice a year. No change of chemical solution during life of battery.

LOW DEPRECIATION: Sturdy, long-life construction.

GREATER CAPACITY in a given amount of space avoids overcrowding.

• • •

Various sizes and types of Exide Batteries are available in plastic containers.

Exide-Manchex is your best battery buy for all control and substation services.

1888 . . . DEPENDABLE BATTERIES FOR 66 YEARS . . . 1954

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 2 • *Exide Batteries of Canada, Limited, Toronto*

"EXIDE" and "MANCHEX" *Reg. T.M. U.S. Pat. Off.*

DAILY
Vol. 113, No. 5
NEW METER GUARANTEED FOR LIFE
Westinghouse Announces Lifetime Meter
DALLAS, TEX., Feb. 3, 1954 — Delegates to the February meeting of the National Meter Committees heard today the announcement of a new Westinghouse Lifetime meter, GUARANTEED FOR LIFE. It is said that it spans all present and future requirements for single-phase service.
YOU CAN BE SURE...IF IT'S
Westinghouse
J-40477

One of these K&M Asbestos Textiles may help you produce a better product or overcome a design difficulty. More than half a century of research and development is in back of these first quality products which are made with utmost care for maximum uniformity and fidelity to specifications. These textiles meet applicable ASTM requirements. Perhaps you have a problem or specific question to place before us.

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA
In Canada: Atlas Asbestos Co., Ltd., Montreal, Toronto, Winnipeg, Vancouver

Nature made asbestos . . .
Keasbey & Mattison has made it serve mankind since 1873

Straight Connectors
All good types— in a complete range of sizes.
Tees—
Multifit, numerous clamp types, bolted, yoke-and-nut tees, etc.
for the Complete line of Conductor Fittings -- see the PENN-UNION Catalog
Grounding Connectors
For all combinations of pipe, rod, flat bar, braid, tubing.
Lugs—
Vitite, clamp types, with multi-slit sleeves; also soldering lugs, shrink fit, etc.
Service Connectors
Yoke-and-nut types; service entrance connectors.
You can find the exact fitting you need in the Penn-Union Catalog— practically every good type, in a complete range of sizes. The few here can only suggest the variety.
We also have thousands of other types— new designs are constantly being added. When you need a special conductor fitting for an unusual service, our engineering staff is always ready to help you.
And— Every Connector is Dependable. When you use any Penn-Union fitting, you are sure of a connector that's reliable mechanically and electrically— carefully designed, thoroughly tested, and manufactured under rigid engineering supervision.
Preferred by Leading Users, who have found that "Penn-Union" on a fitting is their best guarantee of unfailing service.
And—
Meter cabinets, bus supports, motor lead connectors, cable taps, fuse clips, etc.
And—
Terminal blocks, elbows, solderless terminal adapters, dead-end clamps, etc.
Sold by Leading Wholesalers
PENN-UNION ELECTRIC CORP.
Erie, Pa.
Canada: Dominion Cutout Company, Ltd., 250 Richmond St. West, Toronto
THE Complete LINE OF CONDUCTOR FITTINGS
PENN-UNION

Reduced Maintenance
Improved Reliability

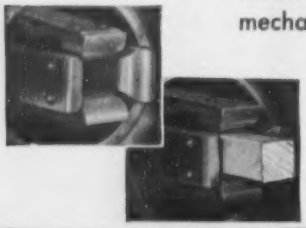
PACIFIC ELECTRIC
Type RHE
CIRCUIT BREAKERS

115, 138, 161 kv — 3 or 5 cycles
196/230 and 230 kv — 3 cycles
to 10,000,000 int. kva (ASA)
at 161 and 230 kv
(Also other types, 7.5 kv and up)

Electrically and Mechanically Trip Free
ASA, AIEE, and NEMA STANDARD

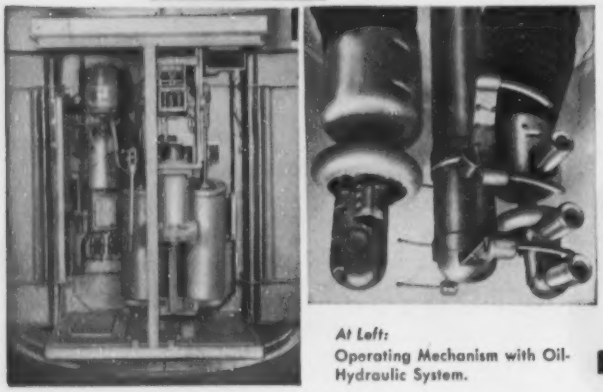
Applicable Standards of ASA, AIEE, and NEMA assure electrical performance of any breaker that meets such requirements . . . but *mechanical* construction, upon which maintenance cost and reliability largely depend, still remains subject to the manufacturer's design approach.

Pacific Electric solicits critical examination of its Type RHE breakers from both the electrical and mechanical standpoints.

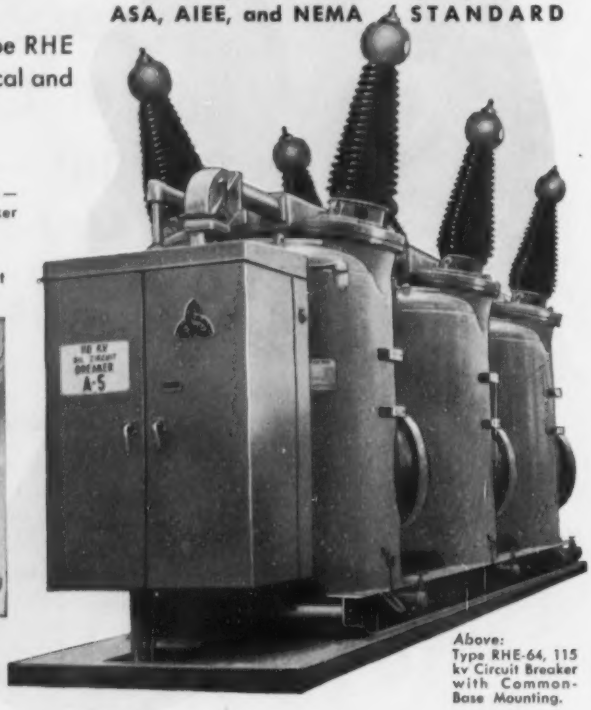


At Left:
Sliding Shoe (finger) Contacts — Six Such Groups in Each Breaker (shown open and closed).

Below:
One-Piece Moving Contact Structure and Interrupters.



At Left:
Operating Mechanism with Oil-Hydraulic System.



Above:
Type RHE-64, 115 kv Circuit Breaker with Common-Base Mounting.

PACIFIC TYPE RHE Breakers embody mechanical features that contribute to low maintenance cost and improved reliability of the breaker and the substation at which it is located. These features assume increasing importance as the upward trend of wages and service salaries continues.

Only One Moving Element in the Tank—Opening accelerating springs and shock absorbers are outside of the tank. As no parts in the tank require service adjustment, maintenance within the tank is largely eliminated. Entrance bushings are under negligible mechanical stress.

Nested Sliding Shoe (finger) Contacts—Self-cleaning; arc foot-points confined to portions of surfaces that do not carry load current; minimizes contact dressing.

Oil-Hydraulic Restoration of Closing Energy—Simple; reliable; lack of tightness of valves does not prevent normal operation—it only slightly increases time for restoration of full energy.

Anti-Friction Bearings—Sealed and lubricated at time of assembly, require no further attention. Lubrication points practically eliminated.

Easy Manual Operation for Load Switching—If control power is lost, the breaker may be closed manually. Then two minute's hand operation of the oil pump prepares the mechanism for O-C-O after fault, or for manual closing after manual opening—all at rated speeds.

These and other advanced features are described in Catalog 585.

PACIFIC ELECTRIC • MFG. CORPORATION •

SUBSIDIARY OF FEDERAL ELECTRIC PRODUCTS COMPANY

5815 THIRD STREET, SAN FRANCISCO 24, CALIFORNIA
OTHER FACTORIES: SANTA CLARA, CALIF.; SCRANTON, PENNA.

Since 1906

SALES OFFICES or AGENCIES in PRINCIPAL CITIES

THIS OIL PURIFIER HAS ASTONISHING DAILY CAPACITY!

SPECIAL FEATURE OF THE DE LAVAL PORTABLE OUTFIT	WHAT THIS MEANS TO THE POWER ENGINEER
✓ Purifier dehydrates the oil in a single pass	✓ Reduces cost of insulating oil purification

Constant high purifying efficiency–no shutdowns for cleaning or for renewal of parts during run ✓

Dehydrates at a single pass–no re-running

Higher daily capacity of insulating oil saves maintenance costs ✓

Heater cannot carbonize the insulating oil

Safest–continuous discharge of water prevents re-contamination of the insulating oil ✓

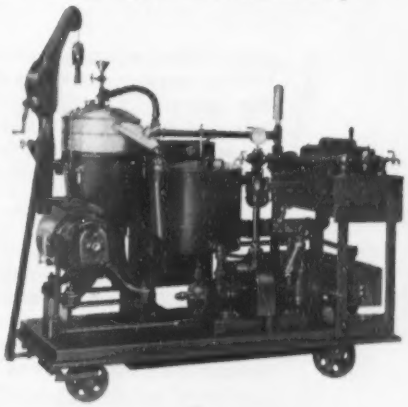
Centrifugal purifier is economical to operate

Removes free water without aid of filter press; press used only to remove colloidal carbon ✓

Low temperature purification; high dielectric value of oil maintained longer

De Laval Insulating Oil Purifiers restore the dielectric strength with one pass through the centrifuge bowl. Because no rerunning is necessary, and because the centrifuge does *all* of the actual work of dehydrating the oil, daily runs can be exceptionally long . . . hence very economical. (A blotter press is furnished only to remove colloidal carbon from circuit breaker oil.)

Among all of the advantages of De Laval purification listed at the left, none is more important than that of ***safety***. Water removed by a De Laval centrifuge is continuously discharged to waste, so can never suddenly and unnoticed recontaminate the oil and reduce it from a high to a low dielectric.



Send for complete details.

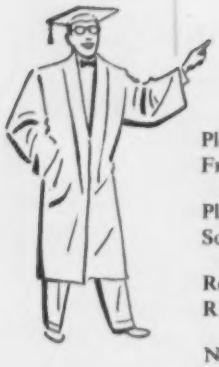
✓ CHECK THESE DE LAVAL SUPERIORITIES

THE DE LAVAL SEPARATOR COMPANY
Chicago POUGHKEEPSIE, N.Y. San Francisco

DE LAVAL

INSULATING OIL PURIFIERS

There's Reliable Power Here for Feedwater Pumps *Year after Year!*



Please examine this great E-M Motor
From bearings to coils to heavy-duty rotor.
Plant auxiliaries run hard and long
So driving motors must be extra-strong.
Read the rhymes and you'll see why
RELIABILITY makes *this* motor your best buy!
No tricky formulas you have to see—
Here we have it in 1-2-3!

Why E-M stresses its ability to design large motors for reliability

1 E-M coils hold moisture out
With high insulation strength all about.
With examination you'll be finding
Repeated varnish coats baked on the winding.
It's earned acceptance and admiration,
This E-M "power house" insulation!

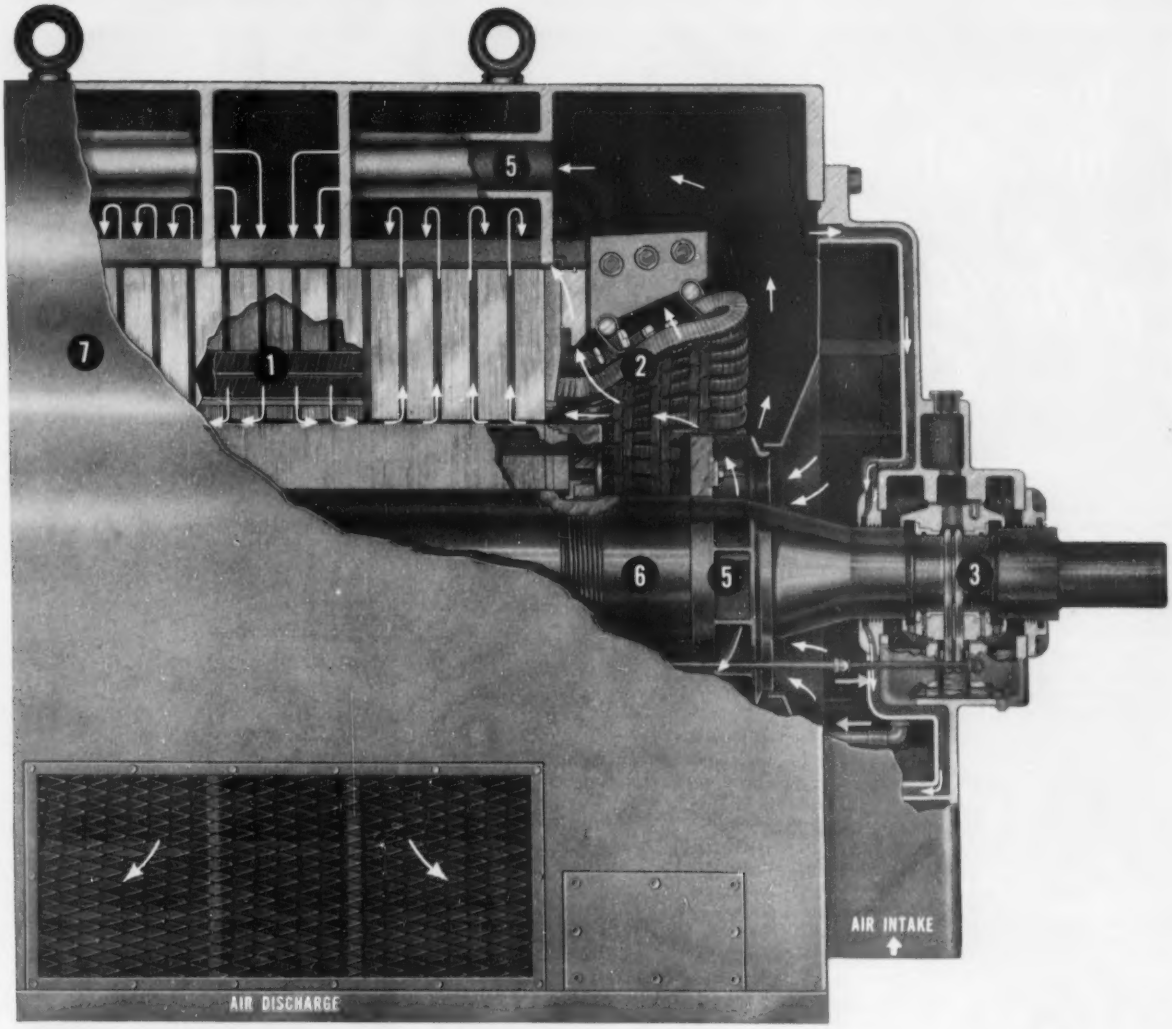
2 You won't find E-M coil-ends in any contortion
Caused by full-voltage starting distortion.
You see, all E-M coils are lashed to each other
And tied to big bracing rings one after another.
You can be sure this E-M coil-end bracing
Is equal to any demand it'll be facing.

3 E-M engineers have had plenty of school
In designing leak-proof bearings that always run cool.
Shaft journals are oscillation-honed so much clearer
Their super finish reflects your face like a mirror.
And the bearing sleeves are centrifugally cast
With strong bond and dense babbitt that last and last.

4 A great deal of your trouble-free operation
Will come from E-M's pressure lubrication.
Take special notice of this choice you are given—
Oil pump can be direct or separately driven.
The oil reservoir gets good ventilation
And it's easy to check the oil circulation.

5 The E-M air distribution is called "Center-flow"
It's uniformly controlled without "big blow".
Aero-dynamically designed blowers have plenty of poise,
Move air efficiently with minimum noise.
You're sure to see, wherever you start,
There's adequate air for each working part.

6 One thing you'll notice about this E-M Motor . . .
Extra-heavy construction of the strong, stiff rotor!
Core laminations have interference fit,
For staying in place, this is really it.
The rotor is balanced with great precision—
A very important smooth-running provision.



E-M 2-Pole Heavy-Duty Squirrel-Cage Induction Motor (1500 HP and larger)

7 One of the most rugged things bearing the E-M name
Is the smoothly-contoured drip-proof frame.
And there's an added noise reduction
In this sleek modern enclosure construction.
It features a "turbine-driven generator" design
When you see it you'll say "This'll be mine!"

These have been some features which you can see—
Large E-M Motors show them tangibly.
Other E-M advantages are behind them, too,
Benefits just as important to you.

For instance, in the field of big motor design
E-M has specialized, straight down the line.
And a broad E-M service organization
Is on "split-second" call across the nation.

When you specify that big motor... now or next year,
Be sure to call an E-M sales engineer.
And before your plant plans get any bolder,
Write for the new big E-M 2-pole Motor folder!

E-M

1300-TPA-2140

ELECTRIC MACHINERY MFG. COMPANY
Minneapolis 13, Minnesota

SPECIALISTS IN MAKING MOTORS DO EXACTLY WHAT YOU WANT THEM TO

In electrical installations *where QUALITY counts* use CONDULETS*

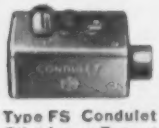
Quality does count in practically every electrical conduit installation that you make. When you use CONDULETS you know that you are putting in electrical equipment of the highest quality, because CONDULETS have been doubly tested . . . in the factory and in the field.

Crouse-Hinds quality control assures a long-lasting product and field records prove it by the test that only time can give. Thousands of CONDULET installations are still in tip-top condition after twenty, thirty, or even more than forty years of dependable service.

The illustration at the right shows four of Crouse-Hinds' basic quality features that are common to all CONDULETS. The fifth, Wedge Nut Fasteners, is an exclusive Crouse-Hinds feature that has made Obround CONDULETS preferred by electricians everywhere.

Type EVA Explosion-Proof Lighting Fixture

Type ARE Arktite Receptacle Equipment



Type FS Condulet With Pilot Lamp Receptacle, Switch and Plug Receptacle

Type GUAC Explosion-Proof Junction Condulet

1. **Taper tapping.** Conduit threads are taper tapped to match tapered conduit threading. Makes a rigid joint that will not loosen. This assures permanent ground continuity . . . important for safety.
2. **Integral bushing.** A smooth rounded surface protects wire insulation.
3. **Material.** Feraloy . . . a special alloy that is strong and tough, resists corrosion, and gives sharp, full threads
4. **Finish.** A triple treatment provides long-lasting protection . . . exceeds Federal and U. L. specifications.
5. **Wedge Nut cover fastener.** Clear cover opening . . . no projections. No loose parts . . . Wedge Nuts and screws self-retained. No screw holes to align.

More than 15000 items are listed in the Condulet Catalog including a complete explosion-proof and dust-tight line for use in hazardous locations.

On your next job, use CONDULETS . . . they're made right to last longer.

**CONDULET is a coined word registered in the U. S. Patent Office. It designates a product made only by the Crouse-Hinds Company.*

Type VC Vaportight Industrial Lighting Fixture

Type FLF Explosion-Proof Manual Motor Starting Switch Condulet

Type EPC Explosion-Proof Motor Starter and Circuit Breaker Condulet

CROUSE-HINDS COMPANY
Syracuse 1, N. Y.

A Nationwide Distribution Through Electrical Wholesalers

OFFICES: Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas — Denver — Detroit — Houston Indianapolis — Kansas City — Los Angles — Milwaukee — Minneapolis — New Orleans — New York — Philadelphia Pittsburgh — Portland, Ore. — San Francisco — Seattle — St. Louis — Tulsa — Washington.
RESIDENT REPRESENTATIVES: Albany — Atlanta — Baltimore — Charlotte — Corpus Christi — Richmond, Va. — Shreveport
Crouse-Hinds Company of Canada, Ltd., Toronto, Ont.

CONDULETS · TRAFFIC SIGNALS · AIRPORT LIGHTING · FLOODLIGHTS

Durasheath: for lower-cost power distribution

DURASHEATH* is a light, tough cable. It is easily installed and thoroughly dependable for series or multiple street lighting, traffic control, and airport† lighting, residential primaries and secondaries as well as for industrial plants and railroads. It may also be used as Type USE cable for underground service entrance.

DURASHEATH cable can save you money. You can run this flexible, easily handled cable underground (buried directly in the earth), overhead or in ducts (or in any combination of these) without needless, time-consuming jointing. Its light weight and flexibility make duct pulling fast even in zero weather. Aerial assemblies go faster. Linemen like to work with it.

* * *

As one of several types of ANACONDA power cables, DURASHEATH is available in all sizes, single or multiconductor, copper or aluminum, from 600 to 15,000 volts. *Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y.*

*Reg. U. S. Pat. Off. 55311

†*when ordered to CAA Specifications L-824*

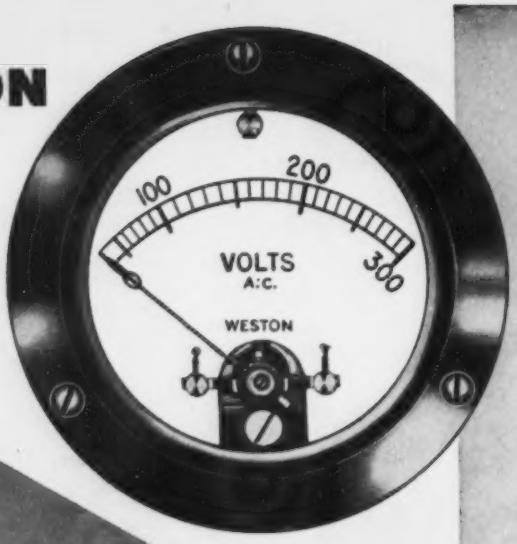
ANACONDA®

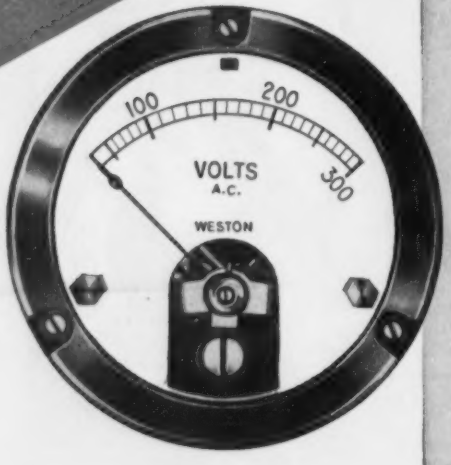
Primary and secondary distribution cables • building, machine tool, control and communication wire • portable cords and cables • bus-drop cables • apparatus cables • copper, aluminum, copperweld conductors • wire and cable accessories.

another **WESTON**

FIRST

A-C ruggedized instruments





WESTON Ruggedized Instruments are available not only in D-C but in movable iron A-C, rectifier type A-C and thermo. *All* are supplied with essential sealed *zero correctors*—shock-resisting flat plastic windows—and connection terminals molded into internal rubber, *leakproof, breakproof and effectively insulated.* For complete details, write for bulletin. Weston Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, New Jersey.

All Weston Ruggedized instruments have externally operated sealed zero correctors.

Insulated, breakproof connection terminals are molded into internal rubber.

Tough, flat plastic windows are really shock resistant.

WESTON ruggedized instruments

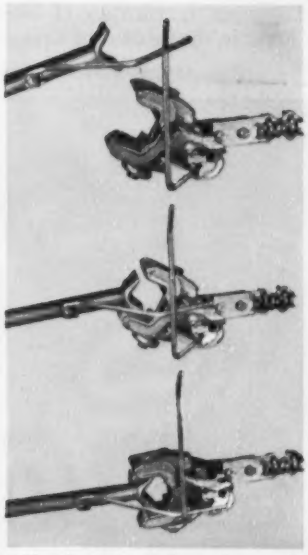
LONG LIFE a measure of SWITCH ECONOMY

The initial cost of an air break switch is only one factor in determining whether it will prove to be an economical investment. Equally important with first cost is the ability of the switch to perform satisfactorily under the most adverse service conditions even after years in the field.

The Type 57-K shown here was built to cost you less by lasting longer. Self-adjusting line contacts that maintain high pressures permanently, non-corrosive greaseless bearings, and a minimum of moving parts all add up to make the 57-K a switch capable of long, dependable service.

The Type 57-K is available in voltage ratings of 7.5 kv through 69 kv and in current ratings of 400, 600 and 1200 amperes.

For complete information write for Bulletin 5457K.

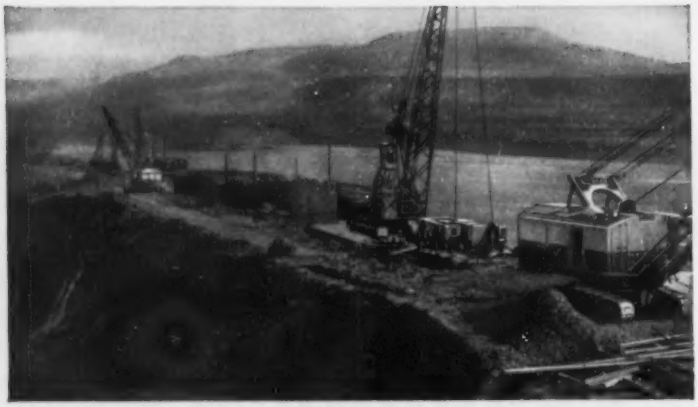


The illustrations above show a closing sequence for the Type 57-K with contacts closing, contacts engaged and contacts fully closed with pressure applied. The 57-K is absolutely dependable under any speed of operation.

Southern States Equipment Corp.
HAMPTON GEORGIA

COMING UP...1,733,200 hp

Excavation for "The Dalles" Dam and Powerhouse Starts as Baldwin-Lima-Hamilton Begins Manufacturing the World's Most Powerful Adjustable Blade Propeller Turbines



THE DAM AND POWERHOUSE at The Dalles begin to take shape as this huge earthmoving equipment goes to work.

Work is now under way in Baldwin-Lima-Hamilton Corporation's Eddystone (Pa.) plant on the first of the fourteen hydraulic turbines they are manufacturing for the Corps of Engineers, U. S. Army, project at "The Dalles." The most powerful adjustable blade propeller turbines in the world, each is rated 123,800 horsepower, 85.7 rpm under 81-ft head. Delivery of these turbines is scheduled to extend through July 1959.

Meanwhile construction of the dam and powerhouse is progressing at The Dalles, Oregon, which is located on the Columbia River between the Bonneville and McNary Dams. When completed in 1960, this project will fulfill a dual purpose. Aside from being a power development, it is also the Corps of Engineers' fourth stage of development of the Columbia River in the interest of navigation at The Dalles.

THE DALLES DAM—Ultimately the power house will contain 22 Hydraulic Turbines with a total rated capacity of 2,723,600 hp.

BALDWIN BLH LIMA-HAMILTON

BALDWIN-LIMA-HAMILTON

Philadelphia 42, Pa. • Offices in Principal Cities

new

EMERGENCY CLOSING DEVICE

portable unit provides full-speed closing of air magnetic breakers

Here's a safe, reliable method of emergency closing an air magnetic breaker onto an energized line where no source of control power is available.

The *Pneu-Draulic* closing device weighs only 40 pounds and can be attached in less than 30 seconds. Its small size (8 x 14 x 10 inches) permits storing near breakers for instant availability. Only one device is needed for all Allis-Chalmers breakers of one type.

Basically, the *Pneu-Draulic* closing device is similar to that in the *Pneu-Draulic* operator for high capacity breakers. Only two moving parts are used to close breaker.

For more information, call your nearby A-C district office or write Allis-Chalmers, Milwaukee 1, Wis.

A-4268

WHY USE THIS CLOSER?

Because it is safe, reliable and fast. An air breaker closing on an energized line must be closed at normal speed. Using the usual manual emergency handle this cannot be done. This device affords the necessary speed.

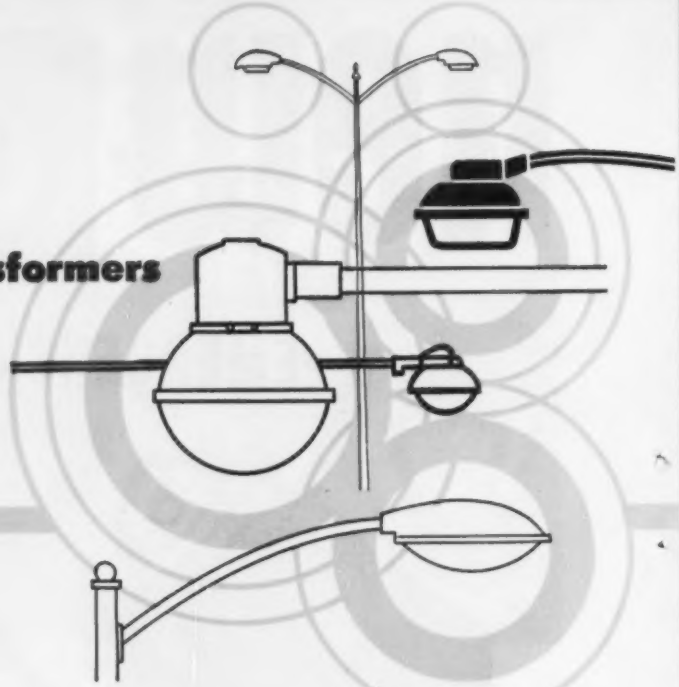
WHEN DO YOU NEED THIS CLOSER?

Whenever any trouble occurs in the source of control power to the breaker. For example: failure of fuses, solenoid, rectifier, relays, wiring, control switch, or control power transformer.

Pneu-Draulic is an Allis-Chalmers trademark.

ALLIS-CHALMERS

high lighting efficiency
low maintenance cost
with Kuhlman Series Transformers



Utility engineers are well aware of the importance of good current regulation to maximum street lighting efficiency. The amount of illumination and length of life of incandescent lamps depends almost entirely on this one factor. Kuhlman engineers, knowing this too, utilize the bent iron core which gives Kuhlman Series Transformers unusually close current regulation, insuring greater lighting efficiency at lower cost for street lighting systems. The construction of the core reduces the exciting current to approximately 75% of that required for butt joint core types at the same core density, thus providing Kuhlman Series Transformers with a guaranteed voltage regulation of 1% over a range from 80% load to 110% load.

Kuhlman Series Transformers permit the use of low voltage cable from transformer to lamp, eliminate system outages that are caused by trouble between the main circuit and the lamp, and help protect lamps from line surges. These units are compound filled and equipped with a drawn copper bearing steel case that is highly resistant to corrosion and practically eliminates maintenance. Kuhlman Series Street Lighting Transformers are made for manhole, pole base or aerial mounting. Utility engineers can get complete information by writing today for Bulletin CS-801. Kuhlman also manufactures Power, Dry Type, Subway, Saf-T-Kuhl, CSP, and Rural Distribution Transformers. Ask for our bulletins on these units also.

145-T

KUHLMAN

KUHLMAN ELECTRIC COMPANY, BAY CITY, MICHIGAN • Southern Division, CRYSTAL SPRINGS, MISSISSIPPI

EXPORT REPRESENTATIVE: INTERNATIONAL STANDARD ELECTRIC CORP., 15TH FLOOR, 50 CHURCH STREET, N. Y. 7, N. Y. CABLE ADDRESS: MICROPHONE, N. Y.

SIXTY YEARS OF PROGRESS IN THE ELECTRICAL INDUSTRY

This rubber "tire" talks to you

Bell Laboratories engineers have developed a new and highly economical way to record sound magnetically.

Instead of tape or wire they use a mixture of rubber and iron oxides which is formed into a band and mounted on a wheel. This simple and very rugged "talking rubber" can play back messages clearly millions of times.

Talking rubber is already at work for the Bell System announcing weather and answering customers who call vacant or disconnected numbers. It promises to have many other uses. In a new machine, it answers your telephone in your own voice when you are away—and takes a message for you in the voice of your caller.

Many businesses, too, other than telephone, are expected to find a variety of ways to use talking rubber—especially whenever a message must be given quickly to many people.

Talking rubber proves again the downright practicality of Bell Laboratories' research to improve telephone service.

One of a bank of recorder-reproducers operated by the New York Telephone Company for the New York Stock Exchange. They give instant stock quotations to brokers who dial a code number. Recording and pickup heads are shown above wheel.

BELL TELEPHONE LABORATORIES

Improving telephone service for America provides careers for creative men in scientific and technical fields.

LOCKE announces advance in

MICRO SUSPENSION

Now the originators of Compression Glaze give you MICROGLAZE SUSPENSION INSULATORS . . . made possible by new Locke discoveries in the all-important porcelain glazing process.

A porcelain insulator's ability to resist impact varies with glaze thickness. Too much glaze . . . or too little . . . will not let the porcelain develop its full potential strength. On MICROGLAZE Insulators, glaze thickness is held within what Locke research has proved to be a *Range of Peak Strength* where resistance to mechanical impact is greatest.

This means that when you order MICROGLAZE SUSPENSION INSULATORS, whether by hundreds or thousands, you can be sure of uniform glaze thickness throughout . . . plus smooth appearance and peak strength.

So let Locke MICROGLAZE Insulators help you fight mechanical impact. No extra cost . . . *but you get so much more for your insulator dollar!*

Suspension Insulator Engineering

GLAZE*
INSULATORS

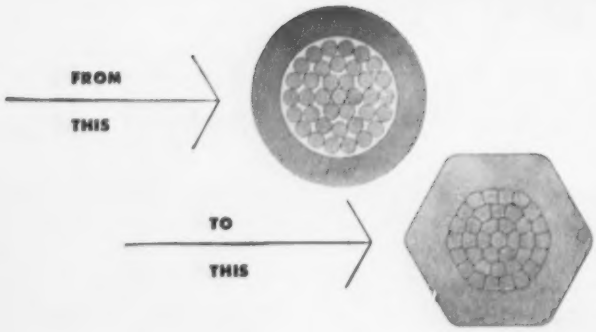
Write today for new 8-page folder titled "The Story of Microglaze Insulators"

LOCKE

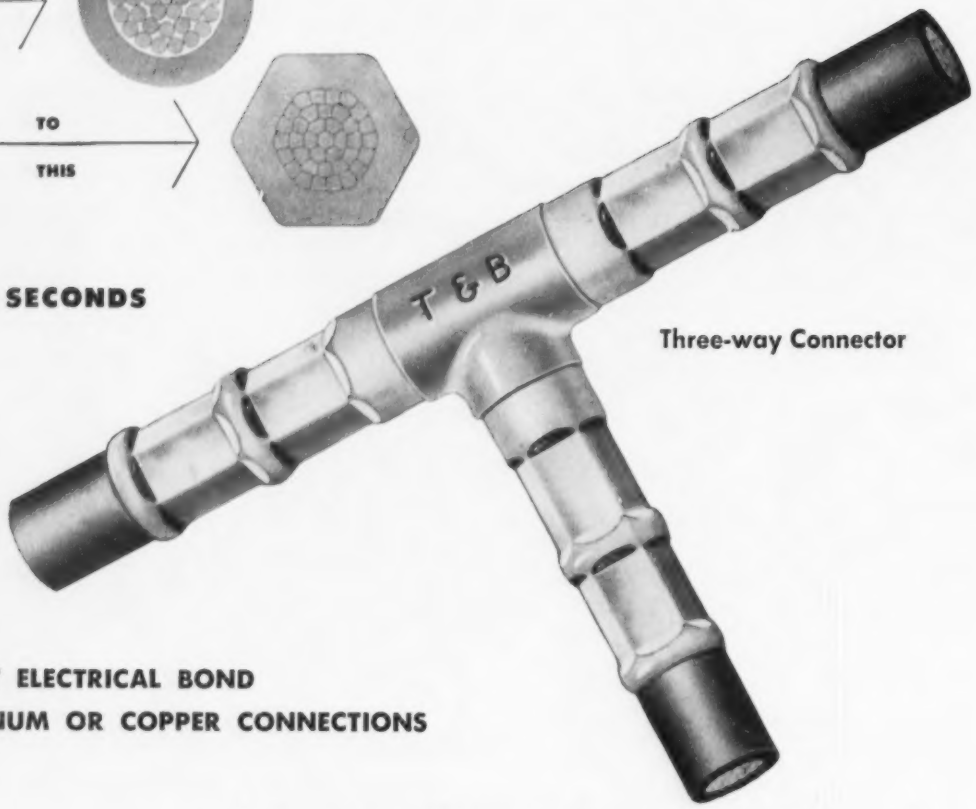
LOCKE DEPARTMENT
GENERAL ELECTRIC COMPANY
BALTIMORE, MARYLAND

*Trademark of General Electric Company

T & B METHOD



...IN SECONDS



Three-way Connector

THE PERFECT ELECTRICAL BOND
FOR ALUMINUM OR COPPER CONNECTIONS

The sign of a perfect electrical compression joint is the T & B hexagonal connector barrel — look for it. The electrical characteristics of a T & B METHOD connection are better than an equal length of conductor . . . either aluminum or copper.

The hardened steel dies of a light-weight, portable T & B hydraulic tool compress around the joint with tremendous hexagonal pressures and force the fitting and cable, into one homogeneous mass . . . all in a few seconds. The all-around pressures exerted over a large area assure maximum contact . . . minimize electrical resistance and voltage drop.

Though the use of an oxide-inhibiting agent is recommended for T & B METHOD *aluminum* connections, no joint compounds are needed to obtain maximum electrical efficiency. For *copper* connections, no special cable treatment is required. T & B METHOD fittings for aluminum have fine serrations inside the barrel which, during compression, penetrate the insulating film of aluminum oxide on the outside cable strands. At the same time, the oxide film on the inner cable strands is effectively abraded, thereby maintaining a dense, tight joint of high conductivity.

Investigate the complete line of T & B fittings for aluminum and copper cable — they offer you savings in time and installation costs. Write for your free copy of T & B Bulletin #67.

LOOK FOR THIS SIGN —

IT'S THE MARK OF AN AUTHORIZED T & B DISTRIBUTOR

The complete line of T & B fittings for conductors and raceways is sold only by recognized electrical wholesalers. It's our way of assuring you the service and savings of a friendly local source. Call him for all your electrical needs. T36

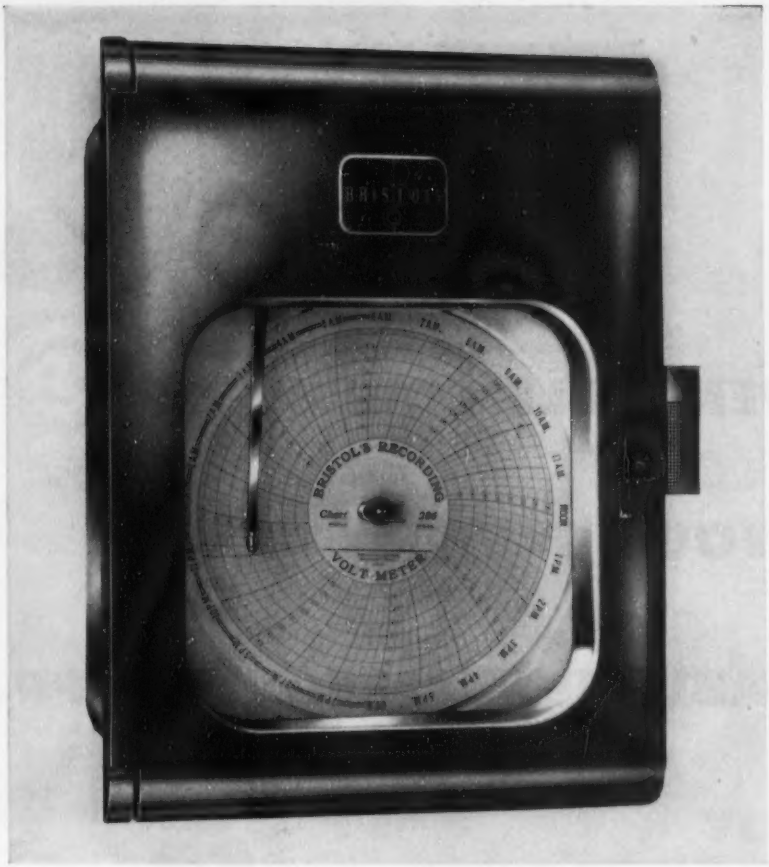
THE THOMAS & BETTS CO.

INCORPORATED

14 Butler Street • Elizabeth 1, New Jersey

Thomas & Betts Ltd., Montreal, P.Q., Canada

MANUFACTURERS OF FINE ELECTRICAL FITTINGS SINCE 1898



NEW, EASY-TO-READ BRISTOL RECORDING VOLTMETERS AND AMMETERS are available for permanent mounting or for use as portable instruments.

You'll get greater accuracy, greater dependability with Bristol recording voltmeters and ammeters

Here's why:

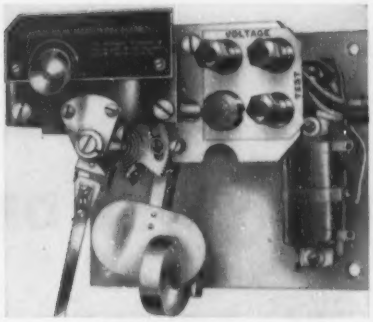
1. Low electrical burden – the lowest burden of any round-chart recorder on the market.
2. Extremely high torque gradient.
3. Temperature compensation.
4. Shock-proof measuring mechanism mounting.
5. Leveling of instrument not critical.
6. Continuously legible recording of sudden changes – up to full scale value.

These modern units are designed for easy use, with dust- and moisture-proof die-cast aluminum case; quick-set chart hub for easy chart changing; non-obscuring pen lifter; and snap-on chart plate.

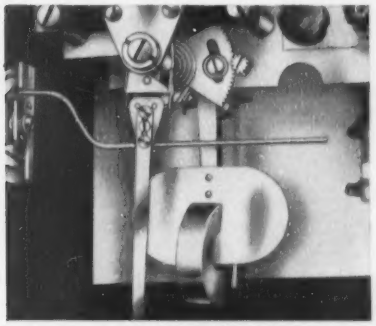
Get the whole story on these precision instruments. Write today for free 28-page Bulletin E1111 to THE BRISTOL COMPANY, 116 Bristol Road, Waterbury 20, Conn.

Many ranges carried in stock for immediate delivery

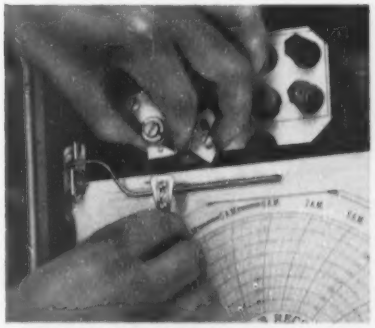
LOOK AT THESE FEATURES!



NEW MEASURING MECHANISM – High-quality, accurate, dependable Bristol moving-iron mechanism used in all models.



MAGNETIC DAMPING – all models equipped with aluminum vane and alnico magnet damper which gives maximum speed of response possible with minimum overshoot.



PEN MOUNTING – Pen-arm mounting shaft firmly supported at both ends – eliminates trouble from back-lash and lost motion. Pen arm is readily removed and replaced.

BRISTOL

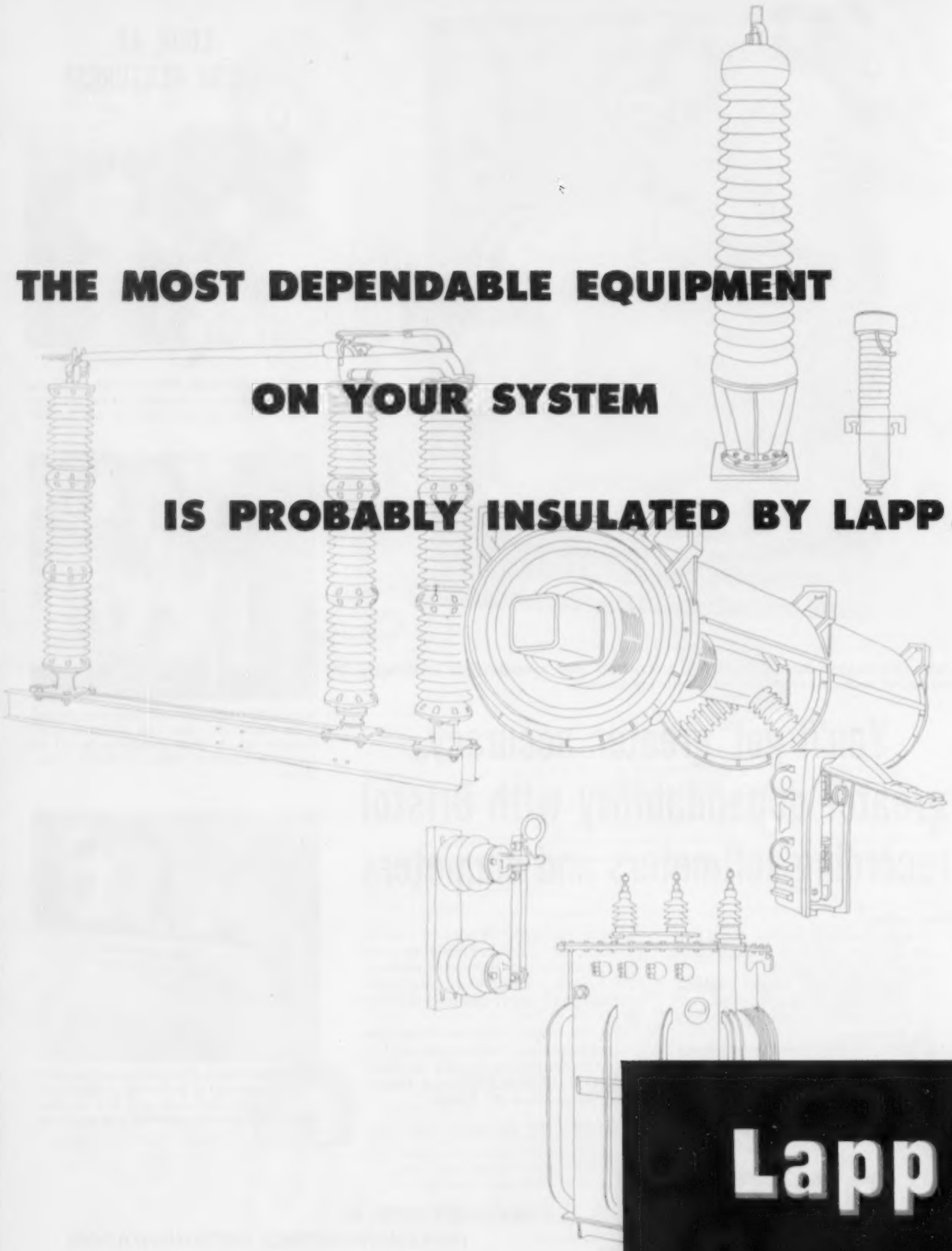
POINTS THE WAY IN HUMAN-ENGINEERED INSTRUMENTATION

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

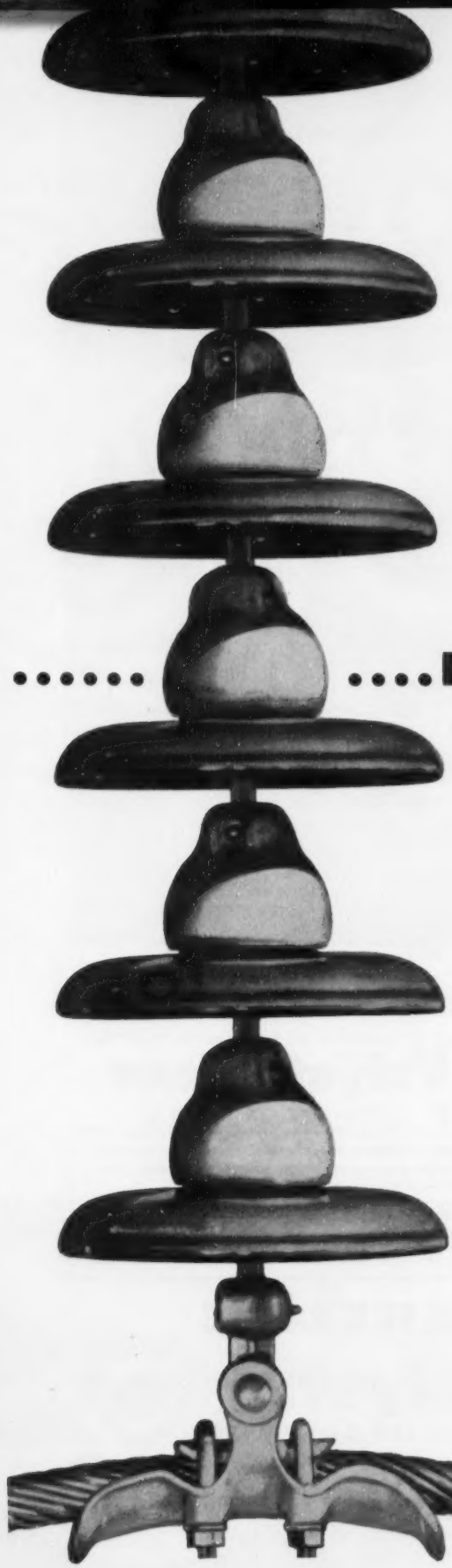
THE MOST DEPENDABLE EQUIPMENT

ON YOUR SYSTEM

IS PROBABLY INSULATED BY LAPP.....



Lapp



....HOW ABOUT

YOUR

TRANSMISSION LINES?

Manufacturers of the best in switches, transformers, lightning arresters, fuse boxes, and other high-voltage electrical equipment look to Lapp for insulators and "special porcelain" insulating components. That's because they know porcelain-and-metal assemblies produced by Lapp offer an extra margin of operating security . . . long life . . . and low upkeep. Lapp porcelain adds value, because it adds dependability, to such equipment.

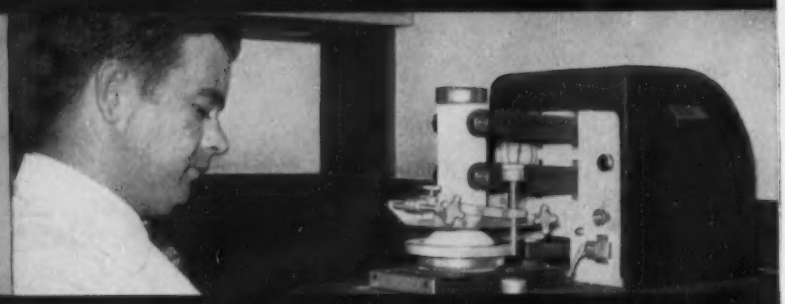
The porcelain-and-metal assembly of which Lapp has made more units than any other, is the 10" suspension disc. This "simple design" has had more research and testing than anything else we have ever worked on.

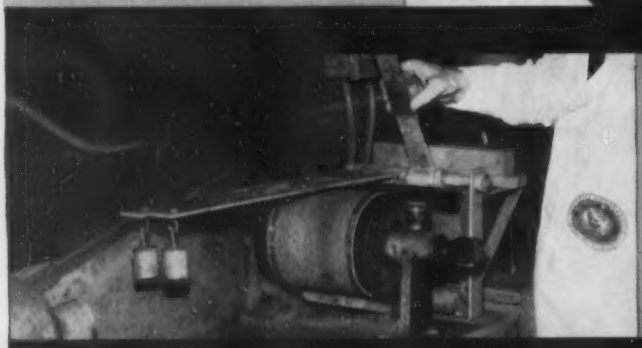
We know, as do hundreds of power companies, that there's no surer way to build security and long service into a transmission line than to hang it on Lapp suspension insulators.

Lapp Insulator Co., Inc., Le Roy, N. Y.

Rubbing BAKELITE Polyethylene samples with reciprocating motion on cold-rolled steel. In 400,000 passes, its loss in thickness was negligible—less than .001 inch. Rubber-type compound showed six times the wear.

Combining reciprocating and circular motions, this machine is shown rubbing test sample of BAKELITE Polyethylene against maple wood. Rubber-type compound lost twice as much thickness as polyethylene in this test.





Here a revolving drum covered with "Aloxite" 320 metal cloth provides continuous, one-direction abrasive effect. It took 2000 revolutions to wear away 45% of polyethylene, while 280 revolutions wore away 80% of a rubber-type compound.

For Line Wire Covering Requiring **WEAR RESISTANCE**

Specify **BAKELITE** TRADE-MARK **Polyethylene**

The wear resistance of BAKELITE Polyethylene is shown by the tests illustrated above and described in a report by the U.S. Testing Co., dated Sept. 24, 1953. In comparison with a well-known rubber-type compound, BAKELITE Polyethylene was tested by rubbing it against various surfaces with a rotary motion, a reciprocating motion, and a combination of both. The abrading agents were "Aloxite" 320 metal cloth, cold-rolled steel, and maple wood.

The results prove the inherent toughness and wear resistance of BAKELITE Polyethylene, and indicate increased use of this material for applications where service conditions will be severe. Line wire covering is an example. Polyethylene is resistant to chemicals, oil, water, immersion, weathering. It won't festoon. It's flexible down to minus 70 deg. C., resists deformation up to 90 deg. C. Light weight and waxy surface make it easy to handle.

Complete details on the abrasion resistance tests are now available in Kabelitems No. 68. To get your copy, write Dept. TM-63

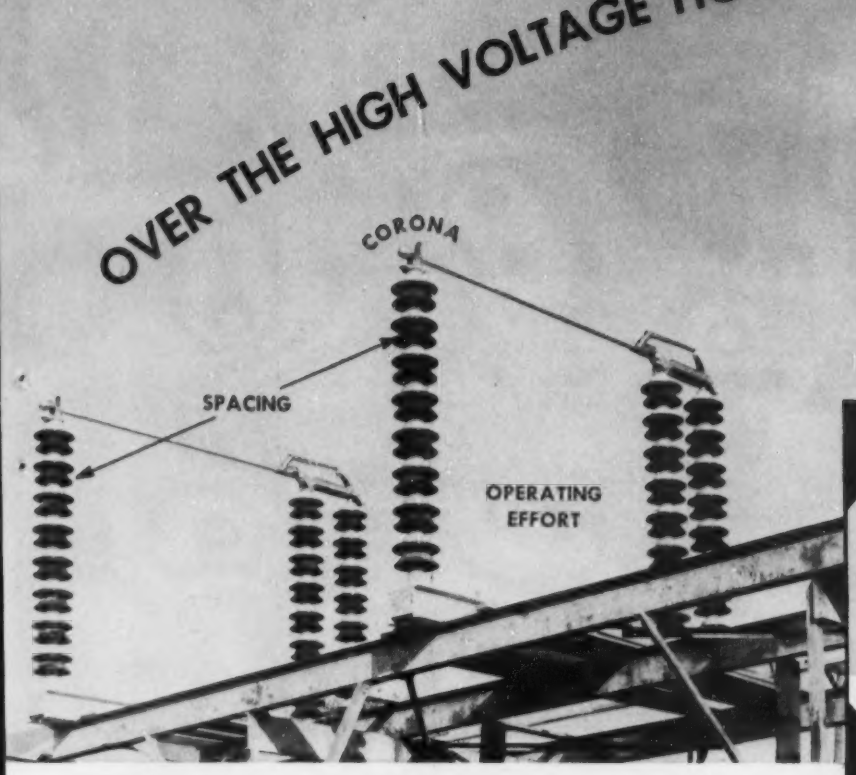
For many electrical applications requiring excellent dielectric properties, these values of BAKELITE Polyethylene (natural) will be of interest:
From 60 cycles to 50 megacycles, at 25 deg. C., *power factor* is 0.00035; *dielectric constant* is 2.30. The material excels in resistance to voltage breakdown. For information on black weather-resistant BAKELITE Polyethylene compounds and their special electrical properties, write for copy of Kabelitems No. 48.

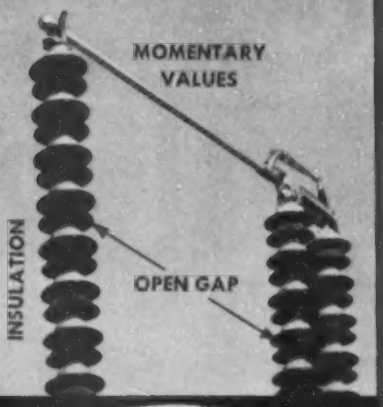
BAKELITE TRADE-MARK
Polyethylene

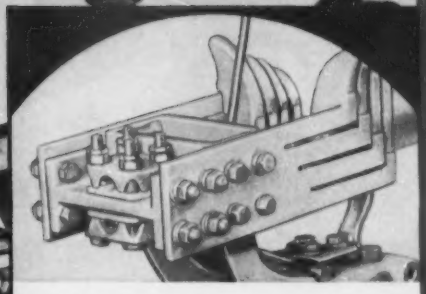
BAKELITE COMPANY
A Division of Union Carbide and Carbon Corporation UCC
30 East 42nd Street, New York 17, N. Y.

In Canada: Bakelite Company
A Division of Union Carbide Canada Limited
Belleville, Ontario

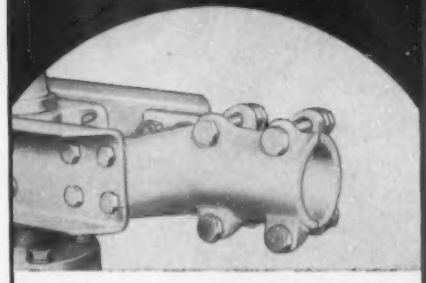
OVER THE HIGH VOLTAGE HORIZON







Straight-thru, Hi-Pressure contact switch jaw for 1600 amp. with high momentary rating.



Round or flat bar conductor easily accomodated in high voltages and high capacities.

R&IE Type TTR49...

preparing for tomorrow

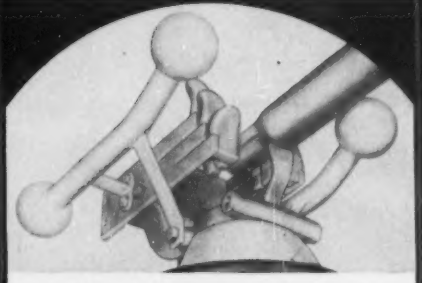
Ultra high voltage switch development has a direct relationship with your normal transmission voltage of today. While determining the factors associated with 330, 400 and 500 kv designs, R&IE engineers also confirm and improve the designs of 34.5, 69 and 115 kv switches. In preparing for tomorrow, R&IE provides more service economy today.

R&IE SWITCHING EQUIPMENT

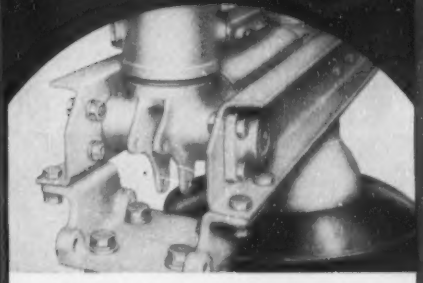
DIVISION OF I-T-E CIRCUIT BREAKER CO.

GREENSBURG, PA.

Recommended type of corona shielding—shown mounted on blade operating mechanism.



Recommended type of corona shielding—shown on jaw end of switch.

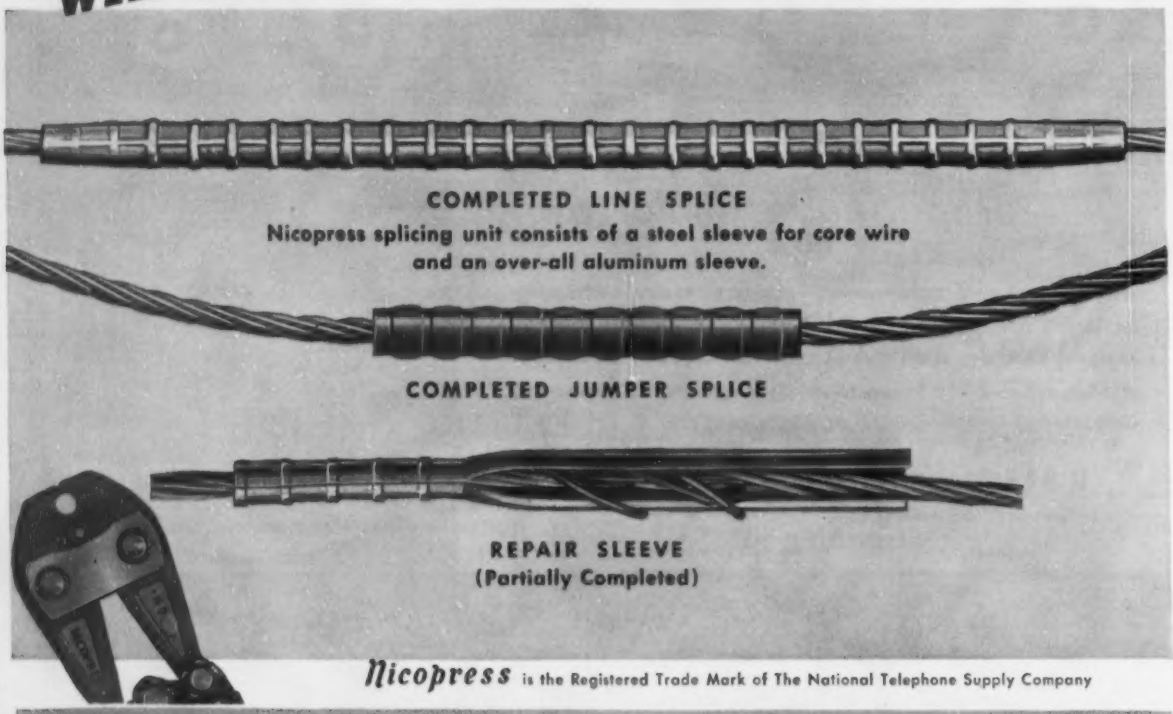


SPHC—Sealed Pressure Hinge Contact—high momentary rating.

INDOOR BUS SUPPORTS and BUS FABRICATION • OUTDOOR BUS SUPPORTS and AIR SWITCHES • SUBSTATION STRUCTURES—steel or aluminum • TESTING DEVICES • KIRK KEY INTERLOCK SYSTEMS • ISOLATED PHASE BUS STRUCTURES • INTERRUPTER SWITCHES

Nicopress SLEEVES for A·C·S·R·

WILL GIVE YOU PEAK PERFORMANCE!



COMPLETED LINE SPLICE

Nicopress splicing unit consists of a steel sleeve for core wire and an over-all aluminum sleeve.

COMPLETED JUMPER SPLICE

REPAIR SLEEVE
(Partially Completed)

Nicopress is the Registered Trade Mark of The National Telephone Supply Company

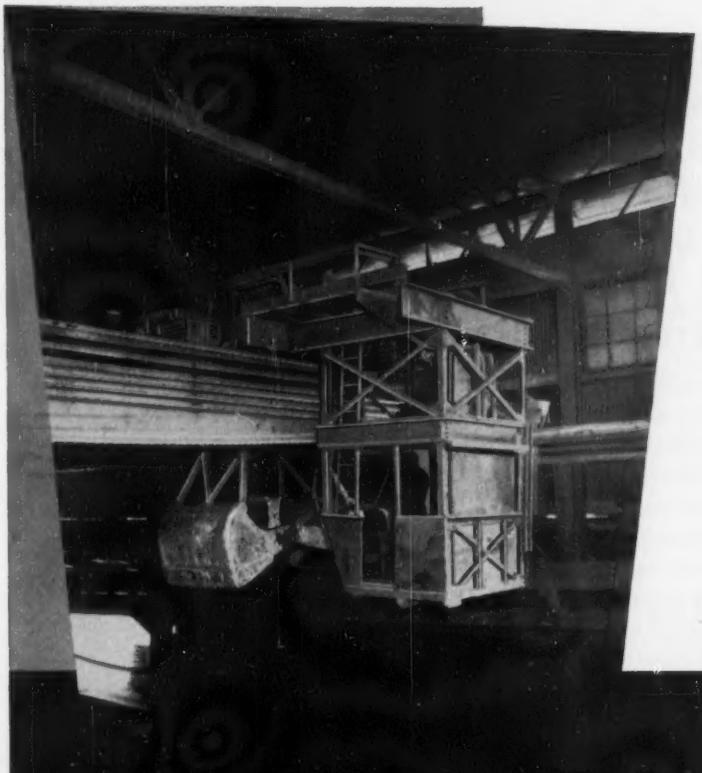
The National Telephone Supply Company

5100 SUPERIOR AVENUE • CLEVELAND 3, OHIO

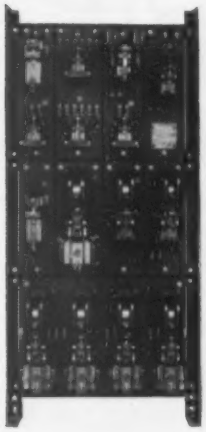
Canadian Mfr.—N. SLATER CO., LTD., HAMILTON, ONT., CANADA

Export Distributor—INTERNATIONAL STANDARD ELECTRIC CORP., NEW YORK, N. Y.

THE NATIONAL TELEPHONE SUPPLY COMPANY



This EC&M Braking Panel replaces all mechanical braking devices in southern fertilizer plant and operates satisfactorily in severe acid atmosphere.



Change-Over to Dynamic Braking Control by EC&M Results in Smoother, Safer Operation of Bucket Cranes

Dynamic Braking Bridge-Stop Control provides an all-electric braking system in which the **driving** motor also acts as the **braking** motor. Operator applies normal stopping by means of a 2-position foot switch which gives two points of dynamic braking depending upon the speed of the crane and the accuracy of stopping desired. Should power fail, dynamic braking is automatically applied to bring the crane to rest quickly, regardless of the position of the master switch.

SOMETHING had to be done! One of the cranes in this plant had partially jumped the runway when power failed at instant of plugging. Ordinary braking methods failed. Magnetically-released, mechanically-set brake wore down rapidly under hard service. Motor burnouts, shaft and gear failures spelled costly delays. Repairs were a nightmare.

So, a change-over was made to all-electric braking. This eliminated costly production delays. Maintenance became merely a routine inspection of motors and controllers. Operation became 100% satisfactory. And the operators warmed up to the smoother stopping.

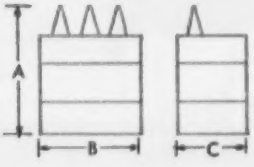
Dynamic Braking Bridge-Stop Control offers advantages for your cranes. May we send you Bulletin 921-6.0?

THE ELECTRIC CONTROLLER & MFG. CO.

2698 EAST 79TH STREET ★ CLEVELAND 4, OHIO

THE A B C's OF TRANSFORMER MANUFACTURE

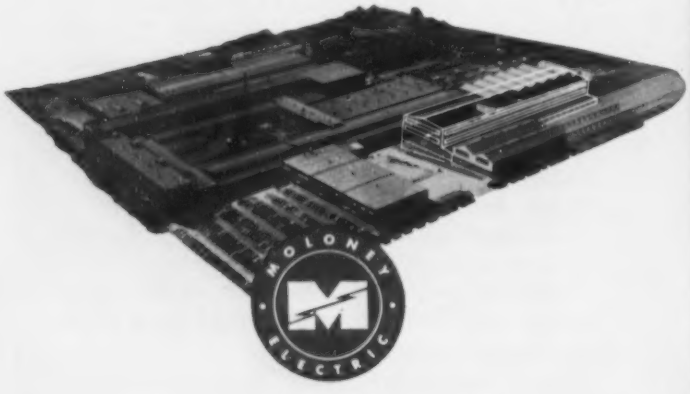
The three dimensions for transformers in the blueprint stage, as shown in diagram, are A, B, and C, the physical measurements of a product. This product would be of little value to today's utility without the coefficient A, B, C of knowledge, facilities, and experience as basic elements of the manufacturer.



The A B C's of transformer manufacture are the combined result of utility demands and manufacturing know-how. Needs expertly calculated by the utilities have made mandatory the possession by manufacturers of A, a high level of knowledge; B, wide facilities; and C, depth of experience.

Moloney is fully qualified in the A, B, C's of transformer manufacture. Since 1896 it has been building and expanding its facilities, its knowledge and its experience to parallel, and to anticipate, utility needs. Now, once again, another long step forward has been taken in increasing facilities here at Moloney so that we can continue to produce transformers capable of superior operation in the high ratings so necessary to today's utility.

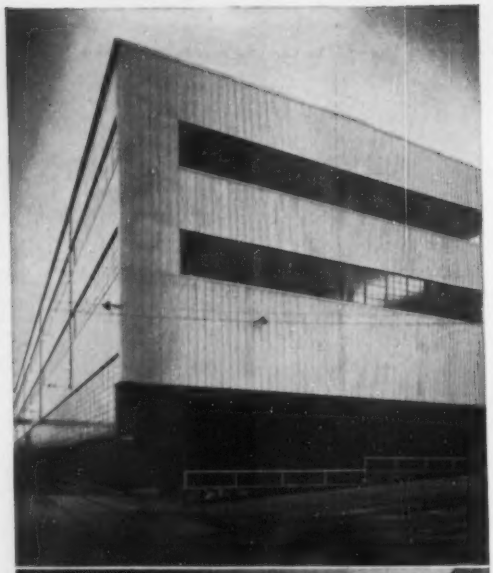
HE54-4

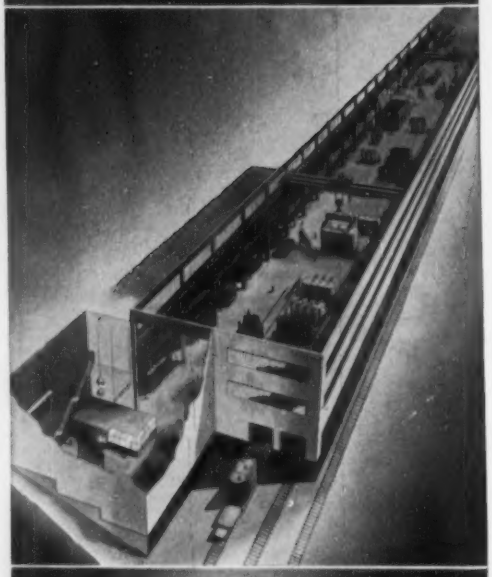


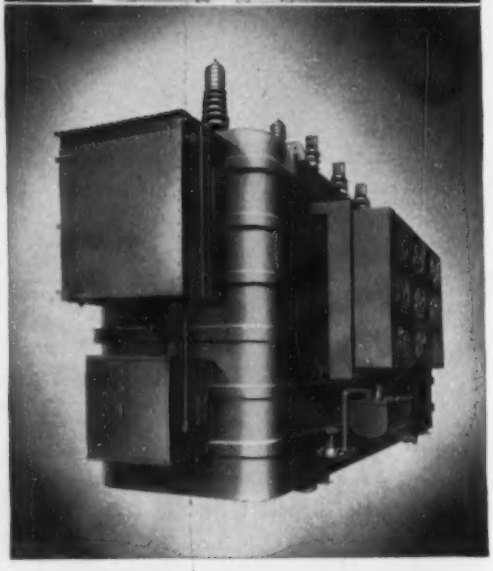
MOLONEY ELECTRIC COMPANY

Manufacturers of Power Transformers • Distribution Transformers • Load Ratio Control Transformers • Step Voltage Regulators • Unit Substations • Electronic Transformers

SALES OFFICES IN ALL PRINCIPAL CITIES







Motors Set the Pace

Motors are the key to setting the new service voltage for large office buildings. A recent American Institute of Electrical Engineers paper detailed the electrical system for a hypothetical 20-story building. Objective of the paper was to prove the economics of higher distribution voltage. But equally impressive was its portrayal of the magnitude of motor load in modern commercial buildings.

This one building alone requires 447 permanently installed motors ranging in size from ½ to 500 hp. Their diversified load exceeds 50% of the estimated total electrical demand. Clearly the electrical system must be built to guarantee service suitable for satisfactory operation of these motors.

Air conditioning, of course, weighs heavily in this computation. But without it—or where by some devious reasoning it is powered by steam or gas—the remaining motor load still approaches 40% of the electric demand.

Few engineers would contemplate other than 3-phase motors for such service. But for most sizes they have a choice of three voltage ratings, designated 208, 220, and 440. The last of these is the one to evaluate in standards for tomorrow's service voltage.

Utilities cannot deliver to all customers under all loading conditions an unchanging specific voltage. They must be satisfied with a limited range of voltage within which customers' equipment will render satisfactory service. Typical of this is the 114/199 Y to 125/217 Y spread designated as "favorable" for 120/208-v service by the EEI-NEMA Joint Committee on Preferred Voltage Ratings.

"Favorable" range for nominal 480-v service is listed by the same authority as 420 to 480 v. But "nominal" here no longer means a mid-point in the spread as it has long been interpreted for lower voltages. Instead it becomes the maximum limit, beyond which customers' equipment may not meet performance requirements. Referring to the new voltage as "480" does not present it in proper relationship to the 120-208 Y with which it must compete. More appropriate is the 266/460 recently proposed by Consolidated Edison Co of New York.

Induction motor power factor is important in this decision. Operation above rated voltage drops power factor. But reducing voltage to improve power factor incurs risk of over-motoring to meet starting or load requirements with equally deleterious effect. In this aspect, too, a 460-v service standard looks attractive, especially when reasonable allowance is made for voltage drop in building wiring.

Prompt and thorough evaluation of these factors is the purpose of EEI's new subcommittee. Its work will be followed by utility engineers and consultants across the nation. For they are keenly aware of the importance of standardization to the future well-being of the industry. They have learned that motors have set the ceiling for 120/208-v service. And they know that motors are the key to the new service voltage standard.

Nuclear Electron-Generator

A battery already 200,000 times as effective as any previous one, converting radioactivity directly into electricity without any intervening thermoelectric cycle, has been announced by Radio Corp of America. David Sarnoff, chairman, and his corps of physicists including Paul Rappaport, the primary discoverer, join in warning that the device does not at once nor in the foreseeable future make obsolete the reactor-powering of the submarine Nautilus. Nor does it make obsolete the modern steam power plant even if it should use nuclear fuel. There is no use, however, denying that the phenomenon of electron-release multiplication manifested in this new strontium-silicon cell has prodigious potentiality.

One-fifth volt and 5 microamperes are derived from 0.5 milligram of strontium 90 attached transistor-fashion to an alloy of antimony in silicon. The resulting millionth of a watt comes about because every electron shot off by the strontium in its 20-year half-life decay knocks 200,000 electrons loose in the silicon element of the transistor.

Soon as anyone mentions a new battery the first question asked is "Is it any good for my car—if not I'm not interested." This skeptic can be reassured at once that the conventional battery can smile smugly for a few years more. To get 6 volts and 150 amperes of engine-cranking current from an array of these gnat-rated gimmicks would require some 900,000,000 of them, that is 30 in series and 30,000,000 in parallel. The strontium alone would weigh 1,000 lb to develop the less than 1.2 hp. How much more the silicon alloy would weigh is dubitable but enough to make the battery outweigh the car.

Let's get excited about the discovery but not about the immediate revolutionary consequences outside the field of communication and electronics. Let's realize that this discovery differs radically by not requiring external energy (thermoelectric pile and electrostatic generators) or consumption of material (chemical cells) nor any moving parts (electrodynamic machines).

Hail! A New Idea!

Practically every discussion of inadequate wiring winds up with agreement that new ideas for grappling with the problem are needed. And few of the discussors have any. And the grappling, such as it is, continues to be done as it has been done.

Now, in answer to the perennial question, "What can be done about it?" a new idea appears. It is the "Package Plan" of the Arrow-Hart & Hegeman Electric Co., which is now being publicized throughout the industry. Under this plan the prospective home owner can specify how he wants his new house wired—with provision for tomorrow or sufficient only for today—by telling his architect he wants the "A" package of wiring devices or the "B." And he will know that the difference between minimum and recommended good wiring will cost him only a trifling amount per month spread over his 20-year mortgage.

The package plan is backed up by a 40-page consumer booklet presenting in comprehensive detail the entire picture of home wiring adequacy. To quote the publicity release describing the book, it "is designed to help the homeowner who is building or remodeling to plan a home complete with every electrical convenience necessary to bring him and his family all the advantages and pleasures of modern electrical living." After close examination of the book, we feel that it does so very well indeed.

It remains to be seen whether or not this "Package Plan" will work. We hope it will. If it does, we can see it spreading, with possible modifications and adaptations, throughout the industry. If it does not, then Arrow-Hart & Hegeman should at least be complimented on coming up with a new idea in a field where new ideas are few.

Two for One in Load Capability

Close to 2 million kw of load have come on the nation's electric utility systems as the result of the installation of room air conditioners. The power factor of this load is around 65%. The load has little or no diversity, and it occurs in summer when high temperatures have reduced system facilities to their lowest capability. In effect, these conditions say that 1 kw of room air conditioner load requires 1.5 kva of distribution transformer capacity, with diminishing kva requirement, but never less than one, all the way back to the generating station.

This load will continue to grow. Already many utilities, and not all in the South, are feeling its impact. New York's Con Edison had a load one day last June within 2% of the system peak in the previous December. There can be no doubt that the seasonal pattern of the electricity system load curve is changing. And the weight of the air conditioning load is a major factor in the change. So it appears likely that for a long time to come the utilities will be stuck with providing 1.5 kva of system capability for each 1 kw of air conditioner load.

But utilities possess the power to rescue themselves from their predicament. The expensive way is to add capacitance. But the cheap way is to promote resistance-type house heating. At lower winter temperatures the 1.5 kva of capability becomes at least 2 kva. Thus the investment made to serve cooling load in summer does double duty by serving the heating load in winter.

GE Talks Up For Private Enterprise

General Electric Co has showed its willingness to step forward and be counted in the ranks of those who support private enterprise in the electric utility field. On Jan. 29 it took advertising space in papers throughout New York to advocate public support for the plan of the state's five private electric companies to redevelop Niagara.

The advertisement pointed out to the residents of the state the cost to them if the New York State Power Authority were given permission to develop the project. Emphasis was placed on the fact that the authority would pay no taxes, the private companies $23 million. Then GE advised the public if it agreed that regulated electric companies should develop the Niagara project to write the Senate Public Works Committee and New York legislators in support of the Capehart-Miller Bill. Passage of this bill would permit the private companies to proceed with their plans.

As one of the state's biggest taxpayers, employers, and users of electricity, General Electric's right to speak out cannot be challenged by any reasonable person. That it did is commendable.

THE ELECTRICAL WEEK

The Issue's News Highlights—SPA and Sepa have been operating in the red, according to official audits.

Industry leaders are dubious about power applications of the RCA atomic battery which converts atomic energy directly into electric energy.

New BPA Administrator William Pearl, returning to Portland after first talks with his Interior superior, said this about policy: "Generally speaking the federal government isn't inclined to spend large sums of money [on power projects]. But there is no feeling any place of curtailing development—but achieving more development by use of all agencies."

Pearl assured the Northwest that all firm and interruptible power loads of BPA can be served throughout the storage draw-down period ending April 15 even though critically low stream flows occur.

FPC license for the United States portion of the St. Lawrence power project was upheld by U. S. circuit court of appeals. Next and last step for project's opponents: the Supreme Court.

Canada's share of the project will be $300 million, up 25% over former estimates, Chairman Robert Saunders of Ontario Hydro-Electric Commission said in Toronto.

Senate Labor Committee held up President Eisenhower's disputed nomination of Albert C. Beeson as a member of NLRB pending detailed study of his relationship with his former California employer.

Sacramento Municipal Utility District has signed a 40-year contract with Interior Department to buy Central Valley [California] Project power starting July 1, when SMUD's contract with Pacific G&E expires. Price for the first 10 years is 4.4 mills per kwhr.

Tennessee Valley Authority has started tests at Kingston, Tenn., on the first unit at the plant on Watt Bar Lake. Ultimate capacity will be 1,440,000 kw.

Anaconda Copper Mining Co, nation's No. 3 copper producer, ordered a 10% cut in output at its Butte, Mont., properties. Work was suspended at two mines and workers transferred to other mines there. Operations will remain on a six-day week, with the men working five days instead of six, as before. (See earlier story on page 158).

Puget Sound P&L stockholder group asked Superior Court in Boston, Mass., to order company to release complete list of shareowners so the group could attempt to elect directors favorable to merger with Washington Water Power Co at Puget's annual meeting.

Off the Washington Wire . . . Interior Department rejected a low bid of an Austrian firm on a transformer for one agency, then accepted the low bid of the same firm for a transformer for another agency.

Moloney Electric Co won a $403,650 contract for an auto-transformer bank for BPA with a bid $135,600 above that of American Elin Co, representing an Austrian firm. Interior said it rejected the lower bid because it did not meet technical specifications. Government of Austria protested the decision. Later, Interior awarded a $233,830 contract to American Elin for an auto-transformer bank for Reclamation's Jamestown, N. D., substation. Lowest comparable U. S. bid was $358,263.

Big push is on to work out arrangements for delivering SPA power to Missouri co-ops. Under present law, no funds will be available for this purpose after Feb. 28. Interior, which bosses SPA, wants to set up an alternative arrangement, under which power companies would lease co-op lines to deliver the power.

California-Oregon Power Co was directed by FPC to file an application for a license for continued operation of five existing projects on the Klamath River. FPC recently decided it had jurisdiction over these dams. At the same time, the commission issued a license to the company to build a sixth dam on the river.

Swan's Island Electric Cooperative on the coast of Maine will be able to lay a 2½-mile submarine cable to bring power to 50 customers on tiny Long Island off Blue Hill Bay as the result of a $43,000 loan approved by REA.

Union Electric Co of Missouri will begin active promotion of complete and auxiliary electric heating at three meetings this week at which heating equipment will be exhibited and discussed.

Public schools topped the list in 1953 for kwhr increase per customer at Carolina P&L. Increase per school was 1,941 kwhr (17.3%) above 1952, reflecting increased installation of electric cooking and water heating equipment and 30-ft-c lighting in classrooms.

Virginia State Corporation Commission retained Ebasco Services to make a cost-of-service study on Virginia Electric & Power Co.

Public Service of New Hampshire received PUC approval to increase rates $1,012,227 annually, compared with $1,029,086 it had requested . . . C. Floyd Nagle, Scranton Electric's president, disclosed his company plans to ask Pennsylvania PUC for a rate increase "about the same" as the one the commission rejected last October. This was $1,179,000 a year.

SPA and Sepa Operating in the Red

• Official audits show mounting power marketing losses for Southwestern and Southeastern Power Administrations

• Reports, prepared under direction of Comptroller General, accuse agencies of numerous mistakes in accounting matters

Federal power operations in the Southwest have plunged in the red by at least $1½ million during the past two fiscal years, an official audit shows.

In the Southeast, revenue from sale of federally produced power for fiscal 1953 was $350,000 short of meeting production and transmission costs according to a second audit report filed with Congress.

These losses are computed on the most favorable figures available—those furnished by the Southwestern and Southeastern Power Administrations which market the power from federal dams in the two areas. If other government figures are used, the power marketing losses for the two agencies run as high as $4 million during these periods.

Detailed story of the mounting deficit of the government's power operations in the Southeast and Southwest is told in two audit reports prepared under the direction of Comptroller General Lindsay Warren, and recently submitted to Congress.

Accounting Errors Noted

Besides the sizable losses incurred, the agencies are also accused of numerous mistakes in accounting. SPA financial operating statement for fiscal 1953 is characterized by the audit as "incomplete and inaccurate for a number of reasons." Sepa's operating statement is merely termed "incomplete."

So-called "net-income" for power sales by the two agencies is exclusive of two important items that loom large in the operating statements of non-federal utilities. These are the amortization of the generating plants and the operating costs of these plants.

Using figures furnished by SPA, itself, the audit indicates the government lost at least $556,392 on its power marketing operations in fiscal 1952 and another $967,636 in fiscal 1953. These are the differences between the annual power charge calculated by SPA on the three hydroelectric projects which were in full operation during these two fiscal years and the net income derived by SPA from all power sales (see table).

Another Set of Figures

For several reasons, this is a much more rosy picture than would be painted by closer accounting:

• Annual power charges used in the calculation are based on SPA's own cost allocations on the generating projects. Army Corps of Engineers, which built the projects, figures the annual power charges for the three projects shown should total $1,229,701—which is $262,065 a year above the SPA figure.

• Although some generating units were in operation at the Bull Shoals and Fort Gibson projects and revenue was derived from them, there is no effort made to assess an annual power charge on the units in operation.

In his report to Congress, the comptroller noted, "We were informed by the administration (SPA) that they recognize the deficiency . . . and it is expected that the power rate schedules will be increased in the near future."

Figuring Sepa revenue and expense on the same basis, this agency shows an operating deficit of $362,266 million for fiscal 1953. It comes about in this way. Annual power charge of the four hydroelectric projects in operation is calculated by Sepa to be $4,778,980. Total net income of the agency exclusive of this cost was $4,416,266.

Corps of Engineers, which also built these projects, figures the annual power charge on the four projects in full operation at $6,129,200. If this figure were used, the Sepa 1953 fiscal deficit would have been $1,712,486.

SPA Administrator Douglas G. Wright and Sepa Administrator Charles W. Leavy are agents of the Secretary of Interior who is charged by law with marketing power from Corps of Engineer projects. The law directs that such power be disposed of "in such a manner as to encourage the most widespread use thereof at the lowest possible rates to consumers consistent with sound business principles, the rate schedules to become effective upon confirmation and approval by the Federal Power Commission."

The Comptroller General's reports place at least part of the blame for the deficits at the doorstep of Congress. Both the reports recommend that Congress "designate specifically" the agency to make the allocation of costs for projects from which power is sold. A jurisdictional dispute between the two marketing agencies and the Corps of Engineers leaves the responsibility up in the air. Both want to use their own figures. An independent auditing agency such as GAO thus has no reliable figures to audit.

"Until definite allocations of the construction costs are made," says the audit, "it will not be possible to evaluate adequately the financial administration of projects in the marketing area of the Southeastern Power Administration." A similar comment was contained in the report on SPA.

Rate Approval Asked

A second step recommended to alleviate the deficit operations is that rate schedules of both agencies be presented to FPC for approval. This is required by law, but as of June 30, 1953, Sepa was marketing power under 15 contracts for which rate schedules had not been approved. The same is still true.

All but one of SPA rate schedules were subject to review and reapproval by FPC in February of last year. Extensions to Dec. 31, were granted, but the rates have still not been approved.

SPA Deficit Grows

	Fiscal 1952	Fiscal 1953
Annual Power Charge for:		
Dennison	$ 880,987	$ 880,987
Narrows	191,164	191,164
Norfork	538,149	538,149
Annual Power Charge Three Projects	1,610,300	1,610,300
Deduct Net Income All Projects	1,053,908	642,664
Additional Revenue Necessary to Cover Costs	$ 556,392	$ 967,636

Source: Comptroller General's Report

Controlling Radio Influence . . .

. . . on American Gas & Electric 330-kv line will be attempted through the cleaning up of splices and conductors

Cleaning up of conductors and splices will be relied upon to control the unexpected high levels of radio influence encountered during preliminary tests of a 49-mile section of 330-kv line (EW, Jan. 25, p 133), engineers of American Gas & Electric Co disclosed before the Winter General Meeting of the American Institute of Electrical Engineers. (Full report on technical sessions appears on pages 74-79 of this issue.)

In a supplement to their technical paper on performance of the 330-kv line at a session on extra high voltage transmission, H. P. St. Clair and C. A. Imburgia said that an investigation covering all phases of conductor manufacture and handling, stringing methods, treatment of joints and repair sleeves is in progress. It may be that the 1.6 in. diameter line conductor will have to be operated, at least for some time, at a voltage below the maximum originally projected. However, to speed construction of lines needed in the near future, conductor size has been increased from 1.6 to 1.75 in. diameter, they said.

Text of Statement . . . The text of the statement read by St. Clair is as follows:

"In order to obtain an actual operating test on a section of 330-kv line in advance of normal operating schedules, a 49-mile section was operated for a period last November with only partially completed switching and transformer arrangements at either end. Some of you may have heard that this initial test disclosed a number of imperfections in the condition of the conductor surface, and in the joints, sleeves and other details, resulting in radio influence levels higher than anticipated.

Investigation Made . . . "A thorough investigation was immediately undertaken and is still being carried on, covering all phases of conductor manufacture and handling, of stringing methods, treatment of joints, repair sleeves, etc., with a view to eliminating the controllable sources of radio influence and obtaining a line with conductors in place in a condition as near as possible to that of a line which has been aged in normal operation over an extended period of time.

"It may be that the 1.6 in. conductor will have to be operated, at least for some time, at a voltage below the maximum originally projected. In order to obtain an additional margin of safety and to expedite the construction of new lines required in the near future, the conductor size for these lines has been increased from 1.6 in. to 1.75 in. in diameter. But the essential thing that is going to be relied upon to control radio influence levels is the cleaning up of the conductors, splices, etc., and this is where most of the trouble lies.

"The results of all the investigations now going on and which we are confident will lead to satisfactory conclusions will be fully reported in due course. The experiences so far encountered, although not fully anticipated, are believed to be entirely commensurate with the kind of problems nearly always encountered in other fields, for example, with higher capacity turbines and boilers, where previous practices and knowledge have been extrapolated."

50 Millionth Electric Customer?

Joseph E. Moulle and his family (above, right) are Cleveland Electric Illuminating Co's candidate for the title of the 50 millionth electric customer, but there are about 599 others who might claim the title.

Edison Electric Institute estimated that the 50 millionth electric customer began receiving service on Jan. 28 between 1 and 2 o'clock (EST). But since about 600 new customers throughout the country were connected during this hour, it never will be known exactly who the 50 millionth customer was.

In common with many utilities, CEI selected its own 50 millionth customer and held a special ceremony tying it in with Light's Diamond Jubilee. R. M. Besse, CEI executive vice president, did the honors by affixing a 50 millionth customer bronze plaque next to the gold-plated meter on the Moulles' new Cleveland home as they and their daughter, Cecilia, and E. H. Howell of General Electric Co's Apparatus Division look on.

Puget P&L Seeks Permit

Puget Sound Power & Light Co of Seattle has filed an application with Federal Power Commission for a preliminary permit for a hydroelectric project on the Upper Baker River near Concrete. Studies show a 60,000 kw plant can be built at the proposed site.

DIRECT CONVERSION of nuclear energy into minute amounts of electrical energy is accomplished by RCA atomic battery, being tested by Paul Rappaport, who helped develop it

Atomic Battery Raises Doubts

Last week Radio Corp of America announced it had developed an atomic battery that converts nuclear energy directly into electrical energy.

Dr E. W. Engstrom, vice president of RCA Laboratories Division, envisioned a day when a power plant would have only an atomic generator connected directly to the highlines. "Boilers, engines, and electric generators," he said, "would then increasingly become elements of the past."

Leaders Dubious . . . Questioned as to their reaction to the announcement, leaders in the field of power and industrial use of atomic energy were, in general, dubious.

Walker Cisler, president of Detroit Edison Co and the Atomic Industrial Forum, pointed to a speech he had given at the Winter General Meeting of AIEE. In that speech he said there was belief among many that it should be possible to convert atomic energy directly into electric energy. The electrical industry, he said, would welcome any practical process of this kind, but so far, none has been forthcoming. "Our efforts," he said, "are therefore directed toward utilization of heat created during nuclear fission." This provides the means for indirect conversion of nuclear energy into power through the standard boiler-turbine-generator cycle.

An atomic physicist familiar with Atomic Energy Commission work in the field pooh-poohed the battery as a future source of commercial amounts of electric power. He said there was nothing particularly new in the announcement "and certainly nothing that gives rise to production of electricity on the scale we are talking about."

He pointed out that whereas an energy conversion factor of 25% was feasible using the indirect method, a conversion factor of only .06 of one per cent had been achieved with the battery. The battery, he said, might be interesting for communications engineers, who may couple it with low-power resistors, but promises nothing fruitful for the electric utilities.

Cost Factor . . . Fischer Black, editor of Electrical World, speaking before the New York Society of Security Analysts, said that it had been calculated that the combination of a sufficient number of these atomic batteries to operate a refrigerator would cost $20 million. "So," he said, "I wouldn't sell my utility stock on the basis of this discovery."

The technical information man for a firm competing with RCA called the announcement "a well-planned publicity stunt."

Gordon Clapp, chairman of Tennessee Valley Authority, said he would be "very interested to watch development of the RCA battery," even though at the present time it presented no practical application for utilities. He said that TVA is studying the indirect conversion process under an agreement with AEC (EW, Dec. 28, p 68) but that at present no studies were under way on direct conversion.

Edgar Dixon, president of Middle South Utilities and head of EEI's committee on atomic energy, said he felt no comment was warranted on the battery at this time.

Told of industry reaction, a spokesman for RCA said the company thought of development of the battery as a commercial power source as a very long-range dream.

"We consider it mainly as a low-power source for things such as transistors," he said. "All we're interested in at the moment and probably for the next few years is in developing it as an electronic product."

(Technical report on the battery will be continued in the next issue of Electrical World.)

More news on page 169

A Progress Report on First Civilian Nuclear Power Plant

Private industry gives signs of increasing interest in participating in building industrial reactor project with the Atomic Energy Commission

Atomic Energy Commission is getting ready to shift into high gear on its first utility-size nuclear power plant, the pressurized water reactor (PWR).

With preliminary research and development "well underway" at Westinghouse Electric Corp, there are these signs of progress on other fronts:

- Industrial firms, mainly electric utilities, are showing an increasing interest in participating in the project.
- Eisenhower budget for fiscal 1955 requests sufficient funds for the project to assure a rapid construction schedule. Congress is certain to go along.
- Policy decisions affecting organization, extent of outside participation, selection of site, design, and other matters are expected within a few months.
- More technical information on the project is beginning to trickle out.

Although no firm proposals for sizable industry participation were in hand last week, AEC officials had received a number of serious responses to its invitations. These were confined mainly to requests for information, but the tenor was enough to inspire hope for significant outside participation.

Funds Available

Request for $35 million for the project during the next fiscal year, along with the $7 million now available, would be enough to cover the bulk of estimated construction costs. Since development and construction is to be carried on over a three or four year period, there would be no holdup because of lack of funds. It is still hoped that private sources will supply at least part of the financial backing.

Industrial firms still have until mid-February to come up with plans for participating in the nuclear power project. These plans will be taken into consideration by the commission in making further policy decisions regarding the PWR. Once these decisions are made, work can begin on a broader scale.

Technical Data

Preliminary design is far enough along to give some indication of cost and engineering factors. Overall construction with an initial fuel loading is now estimated at around $45 million, of which the electric power generating plant would account for some $9 million.

AEC would like to trim this figure as it goes along in order to make the plant more attractive as a future commercial venture. It believes private investment in the plant would increase the incentive to keep costs low.

Officially the capacity of the plant is "a minimum of 60,000 kw" although outside sources estimate the capability may exceed 75,000 kw.

Slightly enriched uranium fuel—uranium with a higher than normal proportion of the isotope U-235—will be the heat source. Water under pressure, to keep it from turning to steam, will be the moderator and coolant. Experiments with the submarine power plant, also a PWR, as well as previous experiments have shown the PWR to be an inherently stable type.

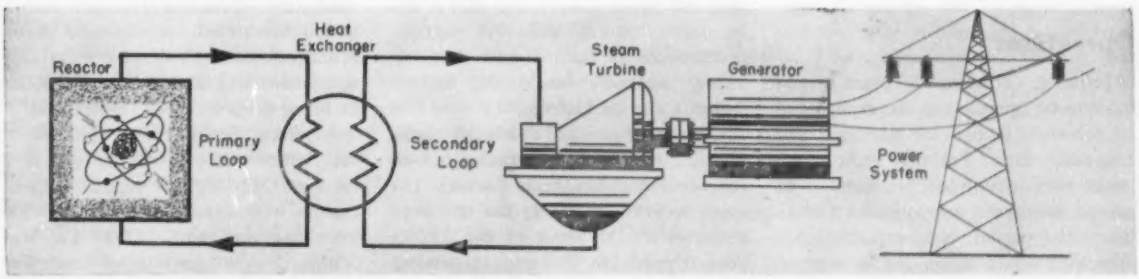
Designed gross heat output of the large-scale PWR will be 900 million Btu's per hour, with plenty of margin to spare. It will produce steam at approximately 600 psia saturated. Because engineers are still charting unknown areas in reactor technology, neither continuity of operation nor actual heat output can be guaranteed until test runs have been made.

Scope of Private Help

Door is still wide open for any and all offers of industry participation in development and construction of the huge project, except for the tasks already assigned Westinghouse. AEC promises seriously to consider all reasonable offers and judge them on the basis of their possible contribution to the interests of the government.

Possible areas of private participation include:

1. Providing a share of funds for design and construction of plant.
2. Providing the site.
3. Operating the plant either alone or in partnership with the government.
4. Marketing the power produced at the plant.



ARTIST'S CONCEPTION of typical electrical generating system using nuclear reactor as "furnace" shows how atomic power plant may work

5. Providing technical assistance in the form of trained personnel to work with project contractors.

6. Providing components of the plant as required by design specifications.

The Westinghouse Job

Development of the reactor, which will power the revolutionary central station plant, has been in progress at Westinghouse's Bettis plant near Pittsburgh since late October when the project was announced. Approximately 1,000 persons are engaged on the design and other phases of the planning. Since the reactor is based partially on previous work done on a large ship nuclear plant, the development is far enough along to make further decisions necessary.

William R. Ellis, who has been with Westinghouse's Atomic Power Division since 1950, is the project engineer. General supervisor is Charles H. Weaver, who heads the company's Atomic Power Division.

As principal contractor for the civilian PWR, Westinghouse is responsible for practically all phases of work dealing with the reactor and the primary coolant circuit. This includes research necessary to development, actual design, engineering, and preparation of plans and specifications.

In addition, Westinghouse will manufacture, assemble and test the reactor and the primary coolant circuit.

Site Selection

Location of the plant is still to be decided, although it is likely that it will be near one of AEC's gaseous diffusion plants at Oak Ridge, Tenn., Paducah, Ky., or Portsmouth, Ohio.

But there is still a chance that it could be placed at some site furnished by an industrial firm or within reach of a load furnished by private utilities. A low-cost site would appeal to the commission, but there would have to be an ample supply of cooling water.

Operations

Initially, at least, the plant would have to be operated on an experimental schedule to provide technical and economic data. For that reason, the loads would have to be such as to permit occasional interruptions. After the initial period, it is expected that schedules would be similar to those of conventional steam plants.

Missouri Basin Power Oversubscribed

Applications already filed for federally generated power to be made available in the Missouri River Basin through 1956 far outrun the anticipated supply.

An analysis of requests received by Jan. 1 show that preference customers have asked for 522,800 kw of capacity and non-preference customers applied for 200,525 kw for a total of 723,325 kw. Total amount of new federal generation expected to be available by the 1956 date is 325,000 kw.

The preliminary figures bear out contentions made by Interior that preference customers needs exceed the supply.

Real problem area is the Eastern Division where new generation will come from these Corps of Engineer dams: Fort Randall in South Dakota, Garrison in North Dakota and Gavins Point in Nebraska. In this area, 170 preference customers have applied for 408,000 kw of additional power although only 166,000 kw is scheduled to come on the line by 1956. In that same area, eight non-preference customers have applied for 134,500 kw (see table).

Also in the Eastern Division, but isolated from the grid, are the Fort Peck and Canyon Ferry power plants. Of the additional 44,000 kw available for contract from Canyon Ferry, only 18,500 kw has been requested by five preference customers. One industrial customer has asked for 1,800 kw. Remaining power in that area likely will be sold to Montana Power Co, which is now buying a portion of it under an interim contract.

In the Western Division where an additional 115,000 kw is to become available during the next three years from the Pole Hill and Flatiron power plants in Colorado, 67 preference customers have requested only 96,300 kw. Additional preference customer applications will be considered ahead of five non-preference applicants which have asked for 64,255 kw of the new capacity.

Missouri Basin Power

Area	New Capacity Available in 1956	Requests	
		Preference Customers	Non-Preference Customers
Western Division	115,000 kw	96,300 kw	64,225 kw
Eastern Division	166,000 kw	408,000 kw	134,500 kw
Canyon Ferry	44,000 kw	18,500 kw	1,800 kw
Totals	325,000 kw	522,800 kw	200,525 kw

CEI Investigating Cause of Outage

Cleveland Electric Illuminating Co late last week still was scratching its head in puzzlement over the cause of a major short-circuit which hit its 132-kv system Jan. 30. Ninety per cent of CEI's 465,000 customers were without power for periods of a few minutes to over two hours.

CEI Vice Pres C. J. Beller said at first it was believed a weather department balloon carrying a trailing wire might have crossed the 132-kv lines. But later it was determined that the balloon had been picked up hours before the power failure and that it had no metal trailing tail. All metallic instruments it carried still were securely wrapped inside the balloon when it was picked up.

Cause of outage was said to be multiple phase-to-phase faults, but no real evidence has been found. The exact location of faults has not been determined. All three of the 132-kv lines tripped out in rapid succession. Minute inspection has revealed nothing unusual—no burn marks, no charred material on line or on ground.

Beller said there was no problem of system stability. The system separated into two parts. One part, connected to Ohio Edison Co's lines, overloaded the tie capacity and tripped out. The frequency went down on that part. On the second part, there was higher-than-normal frequency and except for the parts that CEI took off, that half remained on.

CEI had trouble in getting machines back into operation at some plants, which accounted for slowness in resynchronization. Voltage on auxiliary equipment was so low it was difficult to bring it up to speed, Beller said.

Load on the system at the time of the failure was 614,000 kw out of a total of 1,424,000-kw capacity. Generators with capacity of 761,000 kw were spinning and 75,000 kw was coming in from interconnecting systems.

Youth Gets Industry Attention

Survey by Bozell & Jacobs reveals nation's business firms are engaged in four types of activities to inform students

Industry has its eye on the youth of the nation. Big companies in all industries are eyeing the some 40 million boys and girls who are studying in schools ranging from the first grade to the senior year in college. Part of the interest springs from the present and potential buying markets this group offers. But in addition children are great educators of their parents. Many companies devote considerable time and money to influencing youth to take up careers with their companies or their industries.

These are conclusions to be drawn from a survey of youth activities made by Bozell & Jacobs, public relations counsel for the Electric Companies Public Information Program. The purpose of the survey was to furnish a complete guide to PIP companies who are interested in expanding their youth programs.

B&J found at least four types of youth activities:

1. The most important is supplying "teaching aids" and material to schools. Usually a booklet is supplied to each student while the teacher gets a guide suggesting how the booklet may best be used. Wall charts, film strips, and motion pictures are often supplied in addition.

The survey showed that educators generally want more of this kind of material. They believe overwhelmingly in its reliability but favor association-produced material over that produced by individual companies.

2. Business-education activities received strong support. These may take the form of scholarships, fellowships, or grants. Another form consists of lecture courses, seminars, and workshops. Educators favor the establishment of teacher-business workshops but want them practical and not abstract. They recommend that business representatives serve as instructors.

3. This classification includes activities with groups outside of schools. This includes work with such groups as 4-H Clubs, Future Farmers of America, Boy Scouts, Girl Scouts, and church groups.

4. An indirect activity of some associations and companies is the checking of textbook manuscripts for publishing houses. The Business-Industry Section of the National Science Teachers Association circulates new textbooks in manuscript form to industry associations to give them an opportunity to check facts.

Electric companies are doing their best work in third classification. But in recent years many companies have been improving their youth program to include activities in the first two classifications.

1 of 2 in 300 Entries

When the Art Directors Club of Chicago held its 21st annual exhibit, the newspaper advertisement above was one of the two utility ads selected. Approximately 300 examples of the best in contemporary advertising were displayed. The ad, featuring electric cooking, was prepared for Wisconsin Public Service Corp by its information supervisor, E. V. Christensen, and its advertising agency.

GE Supports Private Development of Niagara

The five New York private electric companies seeking to build the Niagara project have been given the support of General Electric Co. In an advertisement appearing in newspapers throughout New York, the company urged taxpayers to write the U. S. Senate Public Works Committee and their legislators to express support of the Capehart-Miller Bill which would allow the electric companies to proceed with their plan.

The advertisement pointed out that if the New York Power Authority were given the right to develop the project, the result would be a tax-exempt public debt of $400 million.

GE's announcement said that the company, "as one of New York State's largest taxpayers, employing over 67,000 men and women in the state and using 309 million kw hr of energy a year, has an important stake in the most efficient development of more electric power at Niagara.

SCANNING THE ADS

Connecticut Light & Power Co—Ad three columns wide and the depth of a newspaper must have stood out like the power pole (with lineman working on top) that illustrated it. The pole ran the full length of the ad. Partially overprinting it were these words, one to a line, in 72-pt capitals, "Electricity is high in value, low in cost."

Georgia Power Co—Ad telling how women employees dressed 330 dolls for the Salvation Army to distribute to little girls for Christmas was an exceptional piece of emotional writing. Sample: "There are some things that grown-ups can't explain to a child. When a little girl has been a good little girl, how can you say that maybe Santa Claus won't be able to bring the doll she wants for Christmas?"

Philadelphia Electric Co—Center of Industry, one of company's ads to promote Philadelphia as an industrial area, has excellent four-color drawing of the rolling of a steel slab.

A. C. Monteith, AIEE presidential nominee and vice president, Westinghouse Electric Co, witnesses the general session presentation of the Edison Medal to J. F. Peters, consultant to Westinghouse, by AIEE Pres Elgin B. Robertson, head of Elgin B. Robertson Co

Winter General Meeting

AIEE Reports Power System Advances

The Engineering Editors, Electrical World

More papers, more sessions, more attendance (nearly 5,000) than ever before at the AIEE Winter General Meeting also contributed an unusually large group of advances in technology for power systems. Controls for plants and interconnections, one-cycle electronic relaying, system loss evaluation, economical operation, better excitation and cooling, guides for substation design, good industrial systems were typical of the practical contributions. Others dealt with cable capabilities, new rating of circuit breakers, new economic feasibility of railroad electrification. Along with these items of practical import there was extension of fundamental analytical procedures. The latter is best exemplified by the general commendation accorded the W. R. Brownlee paper on loss evaluation.

Research Needed To Guard Utility Future

Papers on the research committee's session reflected a sharp switch from academic exploration to organized attack on pressing problems of electric utility systems. MIT is conducting for BPA an analysis of economic loading, scheduling, and conservation for the Northwest hydro-thermal system. Prof E. W. Boehne outlined the procedure by which optimum results could be achieved despite variations in run-off, irrigation, navigation, loading, losses, etc, through such techniques as the "probabilistic" or the "Monte Carlo" approach along with resort to the extensive computer facilities at MIT.

Heads of two university research groups (J. E. Hobson

of Stanford and W. A. Lewis of Ill. Inst.) explored the question whether the glorious past of the electric utility industry would continue indefinitely into a glorious future unless the utilities safeguard that future by sound research. The railroads thought they were secure and did no research until after they had been "put through the wringer." Implication was that history could repeat. Too much development, the authors felt, has been left to the manufacturers. Enumerated among possible fields of lucrative research were materials, conductors, magnetics, switching phenomena, energy conversion, public and governmental relations. Specifically they mentioned the growing threats to continued overhead distribution and transmission.

Research in the nuclear power field was exemplified by the studies reported by the Dow Chemical-Detroit Edison team on the feasibility analysis. Walker Cisler, president of the utility, and A. P. Donnell, Vitro Corp, said the conversion of U-238 to Pu-239 has been one of the major areas of research but that the potentiality of thorium (Th-232 to U-233) has not been overlooked. The fast reactor they envision need hardly be "bigger than a rain-barrel" but would require circulation of more than 25,000 gpm of liquid sodium coolant, entering at 450 F and leaving near 1,000 F.

One Cycle Electronic Relay Introduced

Electronics has made its pioneer venture into power system relaying. The vehicle is an all-electronic, directional-comparison carrier relay system with a maximum over-all operating time of one cycle. It has been protecting a 43-mile, 132-kv transmission line of Appalachian Electric Power Co and will be installed permanently on American Gas & Electric's 330-kv system in the Ohio valley.

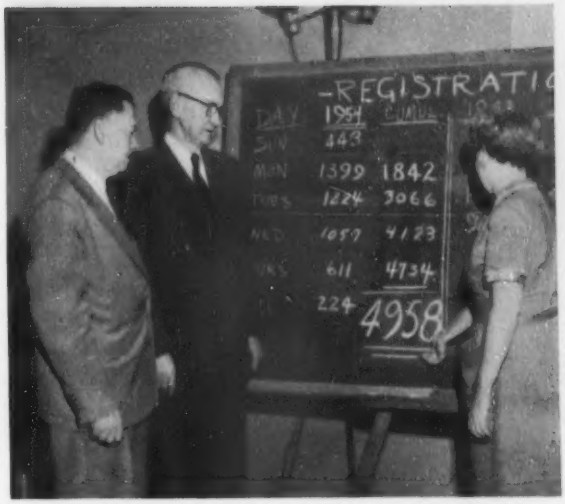
Documentation of this premier venture was recorded in four papers which presented the requirement for one cycle relay time, reasons for electronic methods, description of equipment, and successful laboratory and field tests.

In the introductory paper, H. C. Barnes, AG&E Service, and L. F. Kennedy, General Electric, observed that expanding power systems have pushed protective engineers to faster relaying for transmission economies and essential stability. Until now married to electro-mechanical schemes, relay designers have been eyeing the inertia-and contact-free advantages and potentialities of electronics.

In the companion paper, H. T. Seeley and N. A. Koss, GE, established that the electronic scheme meets requirements for faster relaying speed and that maintenance and reliability aims have been met to as high a degree as possible. While high speed increased complication, they found the resulting cost to be justified by added economies in the transmission system.

M. E. Hodges and R. H. Macpherson, GE, covered operating principles of the relay and W. S. Price, AG&E Service, with R. E. Cordray and R. H. Macpherson, GE, reported correct operation was achieved in 14 of 18 staged fault tests in the field. Causes and cures of incorrect operations were verified in a subsequent series of tests during early December which were the subject of discussion by E. W. Woody, Appalachian Electric Power.

A. H. Burkhalter, Ebasco Services, pointed out that today's trend to larger units and stations is conflicting with a desire for smaller current transformer secondary runs. Larger stations and units call for larger leads as long as 5 amp is the secondary rating. Burkhalter said ½ to 1 amp



Attendance record is tallied by Mrs. M. V. Coffey, AIEE staff, as general chairman C. T. Hatcher and secretary H. H. Henline look on

Inspection trip to Long Island Lighting's operating center finds W. McConnachie, LILCo, with R. C. Judd, Iowa-Illinois G&E, and LILCo vice president E. C. Duffy, who told how the center operates

George E. Dana, NY State Electric & Gas; M. L. Church, Lapp Insulator; A. E. Kilgour, Allis-Chalmers; and A. Van Ryan, Line Material

E. W. Seeger, Cutler-Hammer; S. R. Durand, Allis-Chalmers; D. P. Dinapoli, Pacific G & E; and J. B. Hodtum, Allis-Chalmers

B. Cozzens, LA Water & Power Dpt; E. Sixtus, Federal Electric Products; F. E. Pope, Porcelain Products; and C. F. Dalziel, U. of Calif.

current transformer practice would alleviate the situation and wondered if the electronic relay did not offer such a solution. L. F. Kennedy retorted that the problem of coordinated designs of relays and current transformers is not something to be gone into lightly.

Carrier Current Needs Spectrum Planning

Application of carrier current to power lines must be carefully planned because the frequency spectrum is crowded, said J. C. G. Carter, Westinghouse Electric Corp. Groundwork must be laid by considering the number of channels needed, their routing, path attenuation, line noise, and type of equipment.

The carrier current subcommittee blamed unsatisfactory RF transmission paths for power line carrier difficulties. They advised measurements of the transmission performance of a proposed carrier channel before placing equipment in service. Frequency-shift audio tones provide a high-speed control for micro-wave channels, said L. C. Widmann and D. C. Pinkerton, General Electric. Frequency-shift modulation provides better reliability than amplitude modulation.

Verification by field test of carrier current protection and single-pole reclosing after line-to-ground faults on 230-kv transmission was reported by R. B. Reed and B. C. Hicks, Shawinigan Water & Power Co. Installation on the single-circuit Trenche-Three Rivers line provides directional impedence relaying for short circuits and for ground faults. Reclosing occurs only for single line-to-ground faults after 20 cycles dead time.

Somewhat similar protection is provided for the double-circuit Isle Maligne-Quebec link because experience showed 60% of the faults were simultaneous and involved the same phase on both circuits. Here reclosing is permitted only after single L-g fault of one circuit, or the same phase of both circuits.

H. C. Barnes, American Gas & Electric Service, noted that usual practice recloses three poles, even though only 58% of faults are line-to-ground at 100 kv and above. Objective is equipment reliability through simplification, and prompt restoration after line contact caused by wind. Hicks replied that 3-pole reclosure can prove beneficial where transmission system provides other current paths. But he doubts that such reclosing on isolated single circuits can succeed.

Improved protection for large power transformers is provided by the new relay described by C. A. Mathews, General Electric. Reduced burden and size are achieved by use of a new polarized relay unit. Tuned circuits increase its sensitivity. Design objective is fast operations without false tripping.

In reply to discussion Mathews assured that design provides high thermal capability and vibration resistance.

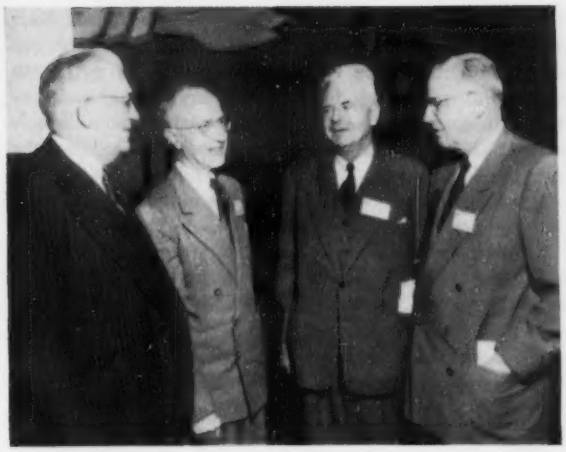
Protection against loss of excitation on generators and synchronous machines is provided by a new relay described by R. L. Tremaine, Westinghouse Electric. This relay recognizes reversed var flow and reduced machine impedence to sound an alarm. The operator is thereby alerted and can attempt to restore excitation. This can be done safely even after the machine loses synchronism, he said.

Continued operation without excitation, or at very low excitations causes excessive heating. Tremaine suggested two to three minutes as the time limit before the operator must trip the machine. As long as voltage does not drop excessively, there is a chance to reestablish excitation without serious disturbance. But a machine must be tripped immediately when voltage drops excessively, he said. The new relay includes an instantaneous element to do this automatically.

E. A. Church, Boston Edison, suggested that a simplified stability analysis would establish when to trip a machine after excitation failure. He noted that omission of voltage regulators increases susceptibility to instability. Both C. R. Joy, Jr., Ebasco Services, and D. H. Cameron, Kansas City Power & Light, noted the growing need for loss-of-field protection on today's larger generators.

Power Plant Controls Must Improve

Controls, interlocking and protective equipment for boilers, turbines and generators were detailed functionally in a group of three papers while a fourth dealt with methods of starting gas turbine generator units. In particular, Westinghouse authors Bryant, Sterrett, and Sauter explained that the large volume of reheat steam between high and intermediate pressure units does not make governing more difficult at light load because later stages in the H P end



H. K. Sels, Public Service E&G; J. H. Foote, Commonwealth Associates; G. Sutherland, formerly of Con Ed; and M. A. Giles, Penn Power Co

L. R. Gaty, Philadelphia Electric, W. B. Morton, Penn Power & Light; G. M. Pollard, Niagara Mohawk Power; and A. J. Higgins, EEI

absorb the work developed in the initial stages. These authors felt load-responsive governing will have to keep step with faster, more rugged load-responsive regulators.

Emphasis was placed by H. C. Barnes and C. P. Lugrin, AG&E Service, on the functional requirements of boiler and turbine controls during remote starting and stopping. The two 200-Mw units at Kanawha were taken as an example of controls coordinated for manipulation by a 7-man shift. This reduces to 1.75 men per 100 Mw. Similarly details were given for large-unit controls by GE authors Cunningham and Eggenberger for such typical functions as governing, overspeed, low vacuum, excess pressure in exhaust hood. They pointed out that the energy stored in the reheat system of an average boiler would be able to lift the whole turbine-generator rotor to a height of 2,500 ft in 15 seconds. This is what the reheat stop valve is intended to prevent.

Controls at Consolidated Edison's Astoria Station are aimed at tripping the units immediately in case of major irregularities, reported R. L. Webb. But time-delay has been added for tripping motoring generators. Negative sequence current relaying was deemed unnecessary because of the speed of system relaying. Also Con Edison prefers to pre-warm the field windings while on turning gear.

Direct cooling of turbogenerators is advancing rapidly, according to generator design engineers. With design ceilings for large machines already lifted by forced cooling of rotors, attention now shifts to the stators. And here different techniques are being explored, two forcing gas through tubes in the coils; the third circulates liquid.

Factory tests on a completely direct-cooled commercial generator have confirmed calculated performance, reported W. C. Brenner and P. R. Heller, Westinghouse. Rated 80 Mw at 0.8 pf with 30 psig hydrogen, this machine weighed only 75% as much as a conventional 80-Mw generator. And 45 psig boosted its capability above 100 Mw. Tests proved the hot gas discharge temperature as an operating measure of winding hot spot. Output is limited by the stator which gains capability as gas pressure is boosted even to 100 psig. Machine synchronous reactance resembled that of the same rating conventional machine, but initial values of short-circuit current approach those of a lower rated machine in the same size frame.

Increased gas pressure and velocity cut core length by half in a 40-Mw generator, said Sterling Beckwith and L. T. Rosenberg, Allis-Chalmers Mfg Co. Projected to 150-Mw units, reduction in space requirements and short-circuit current are estimated to save $200,000 in a typical station. Assembled shipment saves installation time.

Computer analyses of the rotor magnetic circuits guided design changes which contributed efficiency to the direct-cooled generator, said B. M. Koetting and G. W. Staats, also A-C. Trapezoidal slots of tapered depths provided improved flux distribution with heavier copper. And possible substitution of helium was contemplated.

General Electric engineers C. H. Holley and H. D. Taylor reported that direct cooling with 30-psig hydrogen doubled the current capability of a rotor designed for a 100-Mva, 0.5-psig machine. They foresee generators up to 400 Mw if liquid-cooled stators are added. But excitation requirements will soar to 2,000 kw or higher unless reduction of short-circuit ratio can be accepted.

Excitation and Loading Control Discussed

Unless there is a low-end stop to excitation, there can be invasion of instability limits under certain system conditions. This was a point of agreement between Westinghouse and GE authors in discussing the design and functioning of regulators. Differences were detailed by J. T. Carleton and two Westinghouse associates for the Magamp and by A. S. Rubenstein and M. Temoshok for the GE Amplidyne.

Whether the necessity for a lower limit was not in itself a derogation of the excitation regulator was asked by S. Tjepkema, Commonwealth Services. He expressed the feeling that it should be virtually impossible to incur excitation low enough to invite instability.

Two entire sessions continued the field of load and frequency control with emphasis on economy loading. TVA installed a new high-speed control system in 1949. C. P. Almon and John Donalson reported that this variable-frequency telemetering has produced improvements in tie-line regulation over that derived from the earlier impulse duration installation. Tie-line swings are now reduced in about 2½ seconds against an earlier 14 seconds. Also reduction of over-regulation has reduced band width of the regulating units.

E. C. Starr, Oregon State College; O. L. Giersch, Duke Power Company and O. Meier, Jr, Duke University

F. W. McCloska, Sargent & Lundy; I. W. Gross, American Gas & Electric Service Co; and H. A. Cornelius, Commonwealth Edison Co

Mine hoists and steel rolling mills combine to create a cyclic loading not previously experienced on the Ontario Hydro system. C. K. Duff reported that cyclic loads at or near the natural period of tie-lines create magnified and uncontrollable tie-line load swings which reduce energy-transfer capabilities. The solution, at least for loads of one or two-minute cycling, lies in faster and more linear response of governors in conjunction with modern high-speed telemetering and control equipment. J. B. Carolus, Leeds & Northrup, indicated that growth of interconnection tends to make behavior of certain lines "rather rough."

A microwave system augmented by carrier and metallic circuits is serving the pool and individual company communication requirements of the Illinois-Missouri interconnection. D. F. Hazen said his company (Illinois Power) leases some 225 miles of microwave, Central Illinois Public Service 380 miles, and Union Electric 440 miles. All this was indicated as performing satisfactorily.

Ohio Edison has extended its load control and telemetering system to embrace the combusion control at Niles Plant. The overall scheme, said R. H. Travers, functions essentially on tie-line bias (currently 13 Mw per tenth cycle) and spreads regulation over many units. Load control equipment is deemed a necessary adjunct to each new unit. L. F. Ferri, Commonwealth Associates, amplified the presentation by suggesting use of one assembly of regulating equipment for two generating units if their places on the loading schedule do not overlap.

Consolidated Edison expects all its major generating stations to participate automatically in system load changes. H. A. Bauman, C. N. Metcalf, and J. G. Noest collaborated with J. B. Carolus, Leeds & Northrup, in describing automatic computer equipment which compares station loads with present loading schedules to satisfy short-time load swings on a basis of available capabilities and sustained load changes and still meet economy loading requirements.

New Approaches to Loss Evaluation

Extensive and increasingly complex pattern of interconnections has put a premium on ability to predict and balance precisely fuel costs and transmission losses for combinations of plants and lines. It is an ability demanded as much today of the system planner projecting future systems as of the system operator proportioning load among system components. This need explains the urge that drew together the industry's leading system analysts, designers, and power operators at the session on loss evaluation.

In what discussers described as a "classic" paper, W. R. Brownlee, Southern Services, laid down a new method for the determination of incremental losses. It involves two basic assumptions:

1. When small amounts of power are exchanged between generating plants, the bus voltages of these plants are unchanged. But phase angles vary as required to produce the power interchange. Ratios of power and reactive power of the plants vary to maintain bus voltages.

2. Multiple transmission paths between any two generating plants may be represented by a single impedance, commonly called the transfer impedance.

The method has been developed for practical use of voltage phase angles to relate incremental transmission losses between two plants to simple functions of voltage angles and system reactance/resistance ratios. No separate consideration is required of: station voltage levels, transfer impedance between plants, ratios of reactive power to real power, system load distribution, or generation of other plants.

First of a long line of commendatory discussers was E. D. Early, Southern Services. He had compared Brownlee's phase angle method with one based on the partial derivative of the loss equation for an actual case involving plants and lines on the Southern system. The conventional loss equation proved so inaccurate, compared with the new phase angle method, as to shift power generation in exactly the wrong direction.

Also favorably received at this session were two papers on the transmission loss penalty factor computer being built for use by AG&E in conjunction with an incremental fuel cost slide rule. C. A. Imburgia and G. W. Stagg, AG&E, and L. K. Kirchmayer, GE, described the computer design. They were followed by G. H. McDaniel, V. R. Petersen, and A. H. Willennar, AG&E, who dis-

cussed its application to their company's system. E. L. Harder, Westinghouse, acknowledged that his company's device in which "B" constants and fuel factors are set up in the computer yields economic dispatch directly.

Two related papers on loss evaluation dealt with different phases of a joint study conducted by Commonwealth Associates, Consumers Power, and Westinghouse. First of the two described a method long used by Commonwealth Associates by which losses associated with sales power are determined from a family of charts constructed as described in the paper. Second paper developed a method of loss evaluation where the approximations of the first paper were not sufficiently accurate.

EHV Is Focus of Transmission Interest

With the country's first 330/345-kv lines entering their initial operation phases, transmission sessions focused sharply on extra-high voltage with excursions into impulse insulation, design, construction, and performance.

In a supplement to the formal paper by H. P. St. Clair and C. A. Imburgia on design principles, characteristics, and performance of AG&E's new 330-kv line, the authors confirmed rumors that initial tests at this voltage had disclosed imperfections in conductor surface, joints, sleeves, and other details, causing radio influence levels higher than anticipated.

Investigation is covering all phases of conductor manufacture, handling, stringing, treatment of joints and sleeves. It may be, the authors said, that the 1.6-in. conductor will be operated, at least for some time, at a reduced voltage. To obtain additional margin of safety and to speed construction of new lines required in the near future, their conductors have been increased to 1.75 in. But the essential corrective is "cleaning up" conductors, splices, etc. This is where most of the trouble lies, they said.

In a companion discussion of equipment design for the AG&E 330-kv line, F. A. Lane, John K. Kinghorn, and F. M. Porter said recourse to this high voltage introduced new problems and aggravated old ones. Adequate insulation was foremost, but corona and radio interference also had to be considered. It was necessary to get down to hard facts in the design of circuit breakers, transformers, lines, and stations and to eliminate all unnecessary safety factors.

Conclusions based on performance of BPA's 230-kv system will be applied to its 345-kv network now building. H. L. Rorden and R. S. Gens listed these:

1. High speed automatic switching is preferable to continuous overhead ground wires as lightning protection.

2. Reductions of insulation levels seem possible.

3. When arrester protection sets BIL, a more realistic test than a 10x20 current wave should be used.

4. The nature of some stations inherently limits surge voltages.

5. Savings from reduced insulation and tight protection make higher voltages more attractive.

In a carefully prepared progress report J. H. Foote, Commonwealth Associates, chairman of the standards coordinating Committee No. 8, presented recommended new standard values of basic impulse insulation levels for equipment used on grounded or ungrounded ac systems. BIL values adopted follow the 1941 list except for three new values (825, 1175, 1750) and changing 1500 to 1550. Foote's presentation pointed out that his Table 2 was included to show how the proposed new standard correlates preferred nominal system voltages, characteristics of standard valve type arresters and typical allocated BIL's.

J. A. Rawls, Virginia Electric & Power Co; A. S. Anderson, Ebasco Services; and W. S. Peterson, Los Angeles Dept of Water & Power

W. F. Rauber and E. M. Hunter, both General Electric; J. H. Foote, Commonwealth Associates; and F. D. Knight, Connecticut Power Co

Four companion papers by AG&E and Westinghouse engineers reported additional high voltage impulse tests undertaken at Tidd test station. Conclusions were:

1. Corona attenuates and distorts high-voltage traveling waves, more for positive polarity than negative.

2. Attenuation depends on wave shape—one with a long tail being affected less than one with a short tail.

3. For single-line stations, arresters close to the protected apparatus are necessary.

4. Multiple line substations are protected by one set of arresters.

5. When enough dependable lines are in service, arresters may be omitted.

For reports on Substations, Distribution, Cable see pg 164

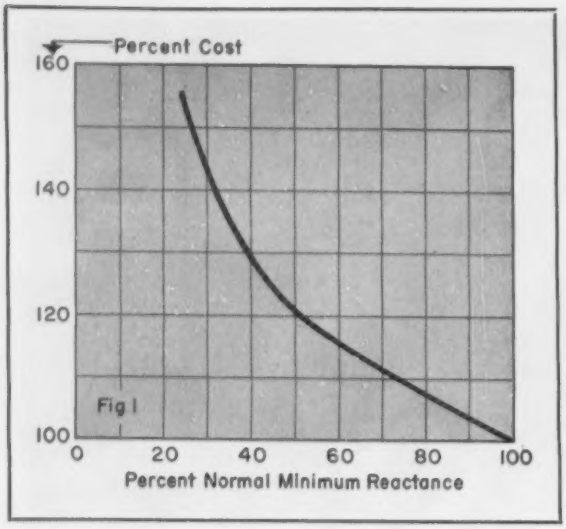


FIG 1—EXAMPLE SHOWS COST of reduced transformer reactance

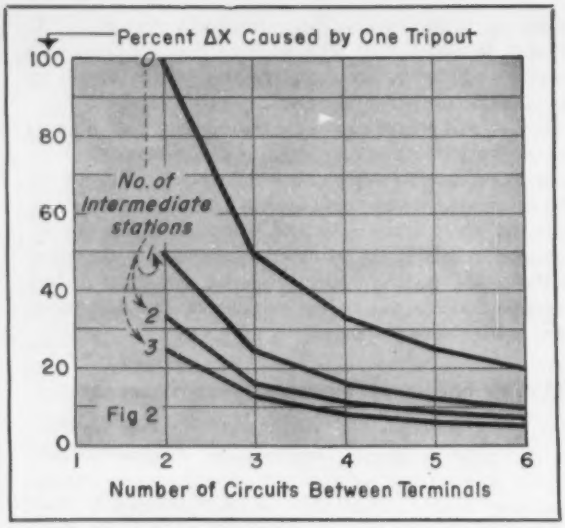


FIG 2—EFFECT ON ΔX of intermediate switching stations

Better System Stability Is Attainable

C. H. **HOFFMAN**, Senior Engineer, Electric Distribution Dept, Public Service Electric & Gas, Newark, N. J.

The overall stability of an electric system can be improved in a number of ways. Many things can be done with respect to lines, equipment, and general system layout to improve stability. Similarly, methods of operation can be altered to accomplish worthwhile results.

Line Characteristics . . . Two transmission line changes can improve stability—a reduction in reactance and a reduction in outage probability. Line reactance can be reduced slightly by decreasing the conductor spacing and increasing the conductor size. Both of these design factors are usually determined by other considerations; but where the choice becomes marginal between alternatives, the stability aspect may influence the decision.

Bundle conductors offer an effective method of reducing reactance. They have been adopted in Sweden, Germany, and Russia for long-distance transmission above 300 kv. Other benefits include reduced resistance, corona, and fewer radio-interference problems.

Reducing the probability of outage benefits stability because critical outages will occur less frequently. Lightning outage probability can be reduced by improving ground-wire protection and by reducing tower-footing resistance. Sleet outage probability can be reduced by employing sleet-melting practices and heavier, more conservative, design for supporting structures. The probability of other failures can be minimized by adopting appropriate counter-measures against earthquakes, airplanes, sabotage, and similar hazards.

Equipment Characteristics . . . Generator changes which reduce reactance and increase inertia will improve stability. Reduced transient reactance has been employed frequently to improve transient stability, but this is expensive. Use of an increased or at least a normal short-circuit ratio is a common way to improve steady-state stability, particularly where dependence on the generator voltage regulating system is undesirable. Use of increased inertia is usually ineffective because high-speed fault removal is almost universal practice today.

High-speed, voltage-regulating systems are of little value for improving the transient stability of very large machines. Time constants are so long that field current cannot be changed appreciably during the critical period regardless of exciter voltage. High-speed systems do improve the steady-state stability situation however. This permits the use of generators with somewhat lower short-circuit ratios and allows operation at lower excitation levels than would otherwise be stable under steady-state conditions. Care should be exercised to assure that the lower limit of excitation for transient stability is not exceeded. If high-speed regulation is essential for stability, consideration should be given to establishing special operating limits when the voltage regulator is out of service.

With ordinary clearing times, the shock to the system comes more from the removal of the faulted line than from the presence of the fault itself. High-speed reclosing successfully restores the faulted line in about 90% of the cases. Of course, the problem associated with high-speed reclosing is what to do about the 10% of the cases which are unsuccessful. Unless these are so infrequent as to be considered negligible, some provision must be made for them. In doing this, some of the economic advantage of the reclosing is lost.

Reduced transformer reactance improves both steady-state and transient stability by reducing system

Ways to Improve Transit Stability and . . .

1. Reduce line reactance using large or bundle conductors.
2. Reduce probability of outages by using adequate countermeasures against lightning, sleet, and other hazards.
3. Achieve low transient reactance in generators.
4. Use high-speed relays and breakers.
5. Design for high-speed reclosing of lines.
6. Employ low-reactance transformers.
7. Plan intermediate switching stations and other layouts for a reduction in the change in reactance, ΔX, from normal to fault-cleared conditions.
8. Employ switched shunt reactors, where applicable.
9. Use series capacitors.
10. Apply appropriate limits to system operations.

Steady-State Stability

1. Reduce line reactance using large or bundle conductors.
2. Increase generator short-circuit ratio; use at least a normal ratio.
3. Use high-speed generator voltage regulating systems.
4. Install automatic load control.
5. Employ low-reactance transformers.
6. Utilize switched shunt reactors where applicable.
7. Use series capacitors.
8. Apply appropriate limits to system operations.

reactance. Since the transformer reactance is an important component of the total system reactance in some cases, the opportunity of reducing it should not be neglected. Fig 1 shows an example of the cost of this improvement. The effect of reduced transformer reactance on short-circuit currents and transformer price should be considered in determining how far to go.

System Layout . . . Stability is also affected by the arrangement of lines and units of equipment in a system layout. A reduction in the change in reactance, ΔX, between normal and fault-cleared conditions will significantly improve transient stability. The more parallel circuits that are available between source and load, the less is system reactance affected by the loss of any one circuit. For this reason a larger number of lower-voltage circuits can constitute a more stable layout than a few high-voltage circuits.

The use of intermediate switching stations has long been recognized as a layout which improves stability. The benefit comes from a reduction in ΔX. Fig 2 shows the effect on ΔX of various numbers of intermediate stations. In general, only diminished returns can be obtained by using more than one or two stations, although a 400-kv line with three intermediate stations has been reported in Russia.

Stability may be affected by the choice between bussing at the high-voltage side of transformers as compared to the low-voltage side. High-voltage bussing results in greater shock to the system while the fault is on, whereas low-voltage bussing causes a greater ΔX when the fault is cleared.

Comparative study of a typical system shows that the effect of ΔX predominates for short-clearing times. One would expect, therefore, that high-voltage bussing is more stable in the usual case. In general, a low-reactance station layout raises the stability limit. This consideration must be compared with the reasons for high reactance.

In addition to the influence of the arrangement of normal facilities, there are special devices available for improving stability. Switched shunt reactors are an interesting and unusual method. They have been employed in several extra-high-voltage systems to absorb the excess line-charging current. By thus making it possible to operate the generators at lower power factor and higher excitation, both steady-state and transient stability limits are extended.

Series capacitors are another means of improving both kinds of stability. They are ordinarily designed to cancel some 30 to 50% of the inductive reactance of the line. As they are protected against system fault currents by short-circuiting devices, they are ineffective during the fault-on portion of a transient disturbance. With fast clearing of faults, however, the benefits of reduced system reactance are available during much of the swing.

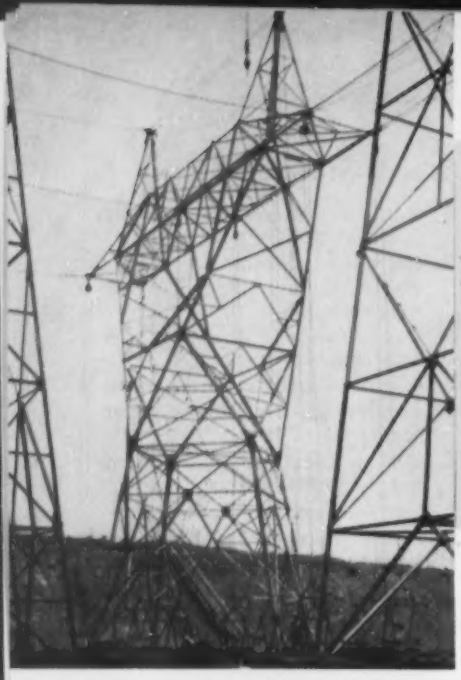
System Operation . . . The importance of the effect of system operating conditions on stability is not always recognized. This factor can be as important as system design and several different problems must be considered. A well-integrated system, with interconnected neighbors, is ordinarily operated so that it is stable under all normal and planned-for emergency conditions.

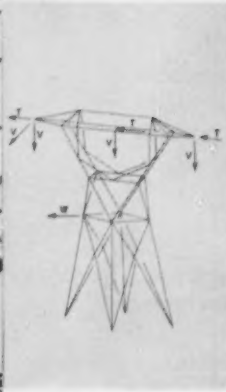
Under such circumstances, equipment loadings must be within steady-state stability limits with all facilities in service. It also requires that loadings be limited to the extent that any one transmission circuit, transformer, or generator can be switched out of service without creating steady-state instability. In many cases these limitations are not burdensome, particularly with high-speed regulation. Another outage which should be considered is the loss of excitation on a single generator.

In addition to the steady-state cases, the system should be examined under transient stability conditions. Limitations on line loadings or on generator power factors may need to be established to allow for certain probable faults and equipment tripouts without excessive swings.

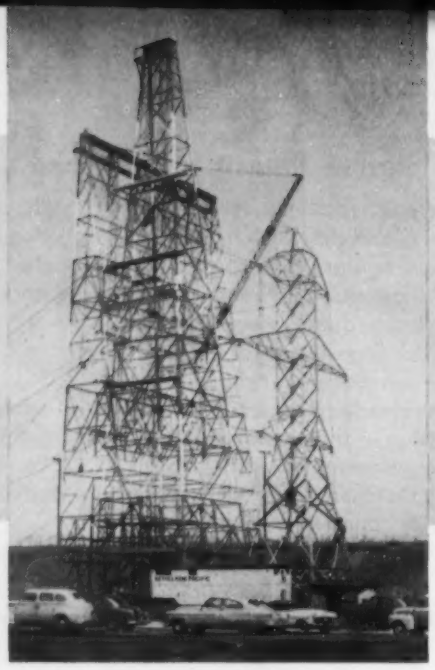
Perhaps the threat to stability which is most difficult to recognize is that of cascading outage. In the case of a large interconnected area, this may involve a number of circuits widely separated geographically and involving operating organizations which are

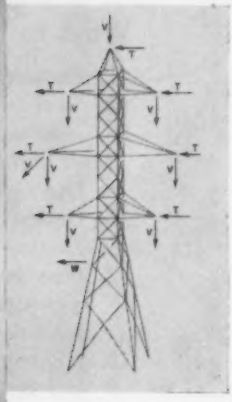
(*Continued on page* 162)





Tests of single and . . .





double-circuit towers . . .

Full-Scale Tests Prove BPA's 345-Kv

A. A. OSIPOVICH, Chief, Transmission Design Section, Bonneville Power Administration, Portland, Ore.

The first 345-kv steel tower, designed for use on two power lines now being built by Bonneville Power Administration, has passed full-scale tests with flying colors. The tower is the first of its type designed and built in the United States. It is of the "rotated" dead-end, heavy-angle type developed by BPA engineers. Full-scale tests were passed also by a double-circuit steel tower design to be used along portions of one of these lines.

The tests were performed on 160-ft frames in the plant of the contractor, Bethlehem Pacific Coast Steel Co, at San Francisco. This is the newest testing equipment of its type, the only similar test set-up in the country is at the American Bridge Co plant at Pittsburgh.

Terrain Is Difficult . . . BPA's Chief Joseph-Snohomish line will be nearly 135 miles long and will be predominantly of single-circuit construction. The McNary-Ross line, which will be about 180 miles long, will consist of mixed single-circuit and double-circuit construction. These lines ultimately will carry 450 Mw apiece. They will traverse the difficult terrain of Washington's Cascade Range. Before line construction can start, extensive road building will be required, and clearing of the rights-of-way will be slow and costly. The location also is such that the structures will be required to withstand unprecedented mechanical loads.

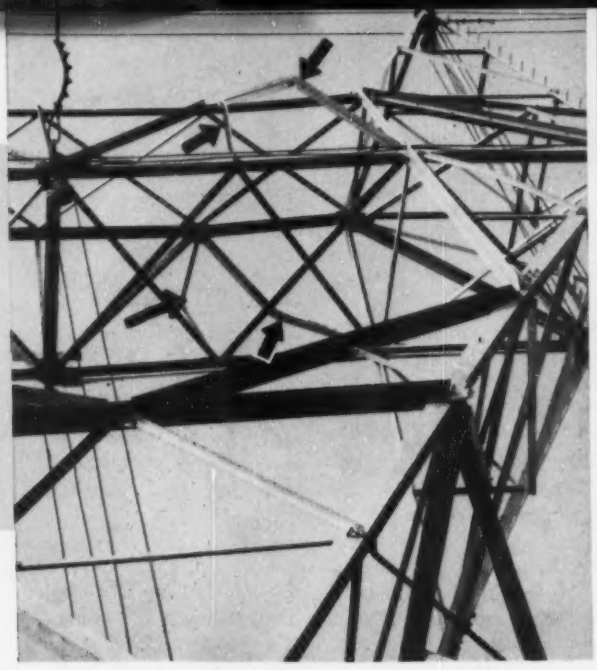
For these reasons it was determined to be wise and prudent to subject several representative structures to full-scale tests before mass fabrication of towers was authorized. In some of the tests, towers were loaded to near destruction. Sum total of all the towers ordered, by type and design, and of tower types tested is shown in Table I.

Selected for the tests were types that represented the largest number of structures in the line, such as tangent-suspension towers L and S. Other types were tested because they will be used at the most critical positions, such as at dead-ends or heavy angles, types D and G.

Tested for "Standard Heavy Loading". . . Towers for both lines were designed in accordance with accepted American practice. Standard conditions include various combinations of vertical, transverse, and longitudinal loads transmitted to towers from conductors and overhead ground wires supported by them. Application of loads to structures tested is shown above. These loads correspond to design conditions designated by the National Electrical Safety Code as "standard heavy loading."

This loading condition assumes the conductor is covered with ½-in. radial ice at 0 F, that there is a transverse wind equivalent to 8 psf on the projected iced area of the conductor, plus a 13-lb wind loading on the tower itself. For test purposes all loads except wind on the tower are increased by 50%, a condition which roughly corresponds to yield-point strength of tower steels used. Loadings for various conditions under which towers were tested are summarized in Table II.

Testing procedure consisted of applying the equivalent of various types of loading by means of dead weights for vertical loads or through chain-block systems. Properly calibrated indicating dynamometers for transverse and



show only minor failures

Tower Designs

longitudinal loads were included in the chain-block systems. Conductor loads were applied at the crossarms. Distributed transverse wind on the tower was applied at one or two panel points on the structure.

A total of 30 individual tests was performed on five structures tested over 27 weeks. Six partial failures were encountered. These required correction before tests could be carried to satisfactory conclusion.

A Weakness Is Easily Corrected . . . As a result of all the tests made, only one major weakness was found. This was in design and make-up of the joint immediately above the spade-plate of single-circuit towers. At this joint are assembled a large number of individual members that come in from several planes. This is the point of actual "rotation" from the diamond arrangement of tower legs to the rectangular position of the crossarm.

This weakness was corrected by simplifying the joint, increasing the number of bolts, and enlargening some of the members entering the joint. As a result of these changes and a few minor adjustments, total weight of the towers has been increased somewhat. Initial and final design weights of all tower types are shown in Table III. However, the total weighted average increase amounts to less than 1.5%.

Tests were considered to be necessary and beneficial, both to BPA and the fabricator, for these reasons:

1. Validity of major design assumption and the correctness of overall design are verified.

2. Nature of failures and their analysis contribute to the art of future design.

3. Assembly of test towers provides an excellent check

Table I—345-Kv Lines Will Use 1,484 Towers

Type		Quantity			
		Single Circuit		Double Circuit	
Designation	Description	Number	Tons	Number	Tons
L*	"Light" tangent	495	3,707	....	.....
S* (1, 2 and 3)	Tangent, no overhead ground wire	296	3,754	244	4,608
A (1 and 2)	Tangent with overhead ground wire	6	108	2	46
B (1, 2 and 3)	Heavy tangent with overhead ground wire	134	2,437	118	3,728
C	Angle suspension, 5–15 deg	22	511	11	413
D*	Angle dead-end, 0–60 deg	75	1,943	66	2,749
G	Angle dead end, 60–90 deg	6	309	9	450
Total number of towers		**1,034**		**450**	
Total weight, including footings			**12,769**		**11,994**
Total estimated cost		**$3,192,250**		**$2,998,500**	

* Towers tested.

Table II—These Loads Tested the Towers

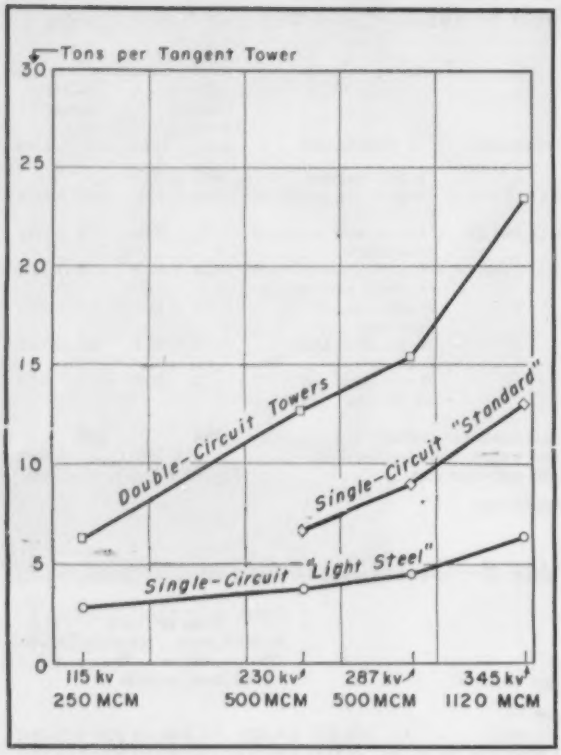
	Type of Tower				
		Single-Circuit		Double-Circuit	
Type of Load	6L	6S	6D	7S	7D
	Total load, pounds				
Case 1					
Vertical	25,200	24,300	75,600	42,300	135,000
Transverse	9,000	11,250	122,100	18,900	137,250
Wind on tower	3,780	4,360	5,000	6,280	8,800
Case 2					
Vertical	.....	48,600	37,800	38,775	67,500
Transverse	.....	.....	61,050	17,325	68,625
Longitudinal	7,500	.....	115,500	22,500	186,000
Wind on tower	.....	.....	5,000	6,280	8,800
Case 3					
Vertical	.....	20,250	61,500	38,775	99,000
Transverse	.....	9,375	99,000	17,325	100,125
Longitudinal	7,500	22,500	43,500	22,500	100,500
Wind on tower	.....	4,360	5,000	6,280	8,800
Case 4					
Vertical	50,400	24,300	66,000	84,600	270,000
Transverse	.....	11,250	107,250	.....	.....
Longitudinal	.....	22,500	28,500	.....	.....
Wind on tower	.....	4,360	5,000	.....	.....
Destruction					
Vertical	14,000	20,250	.....	.....	.....
Transverse	5,000	9,375	.....	.....	.....
Longitudinal	10,600	36,000*	.....	.....	.....
Wind on tower	3,780	4,360	.....	.....	.....

* No failures, test stopped.

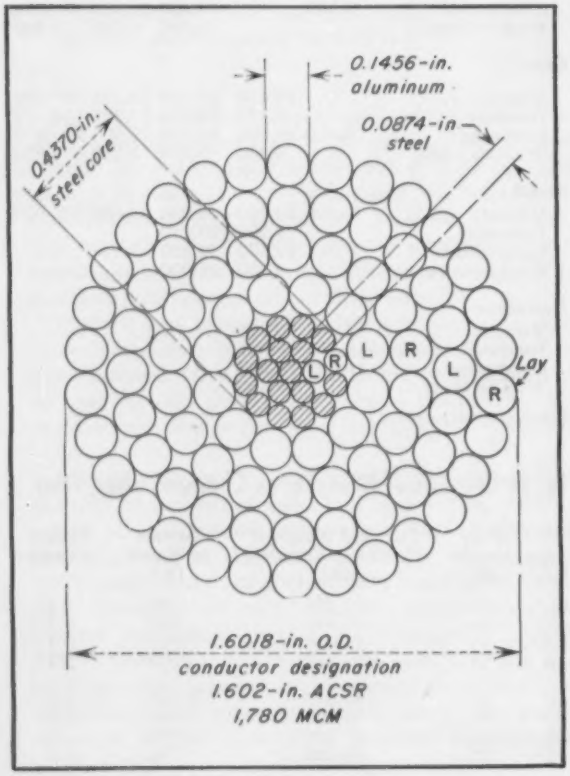
Table III—Tower Weights as Changed after Tests

Type	Body Height (ft)	Estimated Weight of 75-ft Tower Complete (lb)	Increase in Weight (lb)	Percent Increase
6L*	55	12,433	220	1.8
6S*	55	20,470	150	0.7
6A	55	25,000	125	0.5
6B	55	28,840	200	0.7
6C	55	40,672	2,260	5.5
6D*	45	50,680	2,920	5.8
6G	45	65,980	3,000	4.6
7S*	55	33,000	590	1.8
7A	55	39,910	630	1.6
7B	55	53,870	670	1.2
7C	55	66,180	740	1.1
7D*	45	78,262	480	0.6
7G	45	95,543	1,220	1.3

* Towers tested.



PARABOLIC RELATIONSHIP between the weight of steel transmission towers and the voltage of lines they will carry is shown in the chart



345-KV CONDUCTOR will have copper equivalent of 1,120 MCM, ultimate strength of 53,650 lb. Two lines will have 450 circuit-miles

of shop fabrication details. Ease or difficulty of erection also is checked.

4. Maximum design and cost economy are achieved through proper and tested distribution of materials in the structure.

Maximum operational reliability is assured when structures prove capable of withstanding prescribed design and test loads.

Test Costs Were Reasonable . . . Total costs of the testing was $50,950. If this cost is charged to the first order for towers, it will amount to $2 per ton of steel. However, if the total amount is spread over the entire tonnage which will be needed for lines to be constructed in the next few years, then test costs amount to only 45¢ per ton. In either case these costs must be considered very reasonable in view of the results achieved.

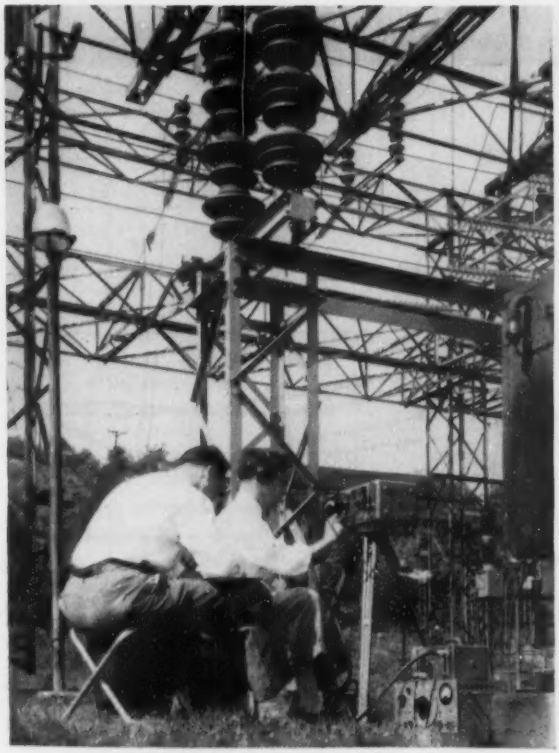
Results Important to the Industry . . . Tower-line design is of growing importance to the industry. It is being pushed to the fore by the current trend toward transmitting bulk electric power at high voltages. There are a number of high-voltage lines in operation in Europe. In North America, British Columbia Electric Co and BPA have both selected 345-kv for their major grid lines. This is the highest voltage so far adopted on this continent. But a number of other companies have selected voltages between 300 and 345 kv.

So far most of the higher-voltage lines have been designed for erection in areas that can be considered rural. There may be additional problems when it becomes necessary to erect such lines in heavily populated areas.

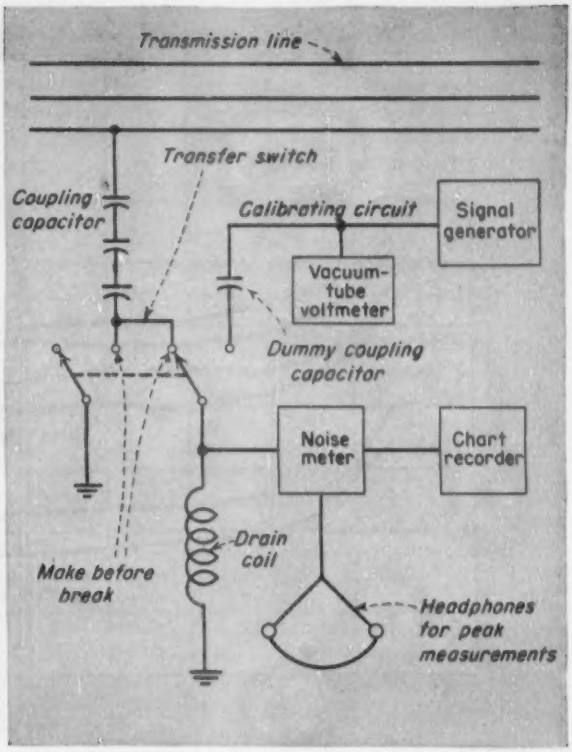
Design Factors of High-Voltage Lines . . . As the voltage of a transmission line increases, so do the several important factors that influence the size and strength of the supporting structures. For example, insulation requirements and minimum design distances from conductor to structure surfaces, coupled with the geometry of the structures, determine the phase-to-phase spacing and the minimum length of cross arms. The minimum clearance from conductor to ground at maximum sag for the established design conditions and span influence the basic height of the towers.

Finally, the size and type of the conductors required to meet the electrical and mechanical conditions involved in very high-voltage transmission determine the magnitude of the physical loads imposed by them upon the supporting structures. As a consequence, these structures will grow larger, stronger, heavier, and more costly with the increase in line voltage. In this connection it may be interesting to note that the weight of steel transmission towers varies, generally speaking, somewhat in a parabolic relationship with the voltage rating of the lines they support.

Tests Advanced Tower Design . . . It was partly with these factors and trends in mind that the engineers of Bethlehem Pacific Coast and BPA conducted the tests on the towers. As a result of them they have arrived at a design for a structure of maximum strength with minimum weight. They also have assured themselves of a design which provides a high degree of reliability with economy. This is why all parties concerned believe that they have contributed to the advancement of the art of steel tower design.



PORTABLE EQUIPMENT MEASURES NOISE at many utility substations. Existing coupling devices often provide the connection points



TESTING EQUIPMENT is connected to coupling device by DPDT switch. Alternate position grounds device, connects calibrating circuit

Noise Limits Power-Line Carrier

J. D. MOYNIHAN, Electric Utility Engineer, Westinghouse Electric Corp

Power-line noise has become an important factor in the application of carrier communication equipment. It produces in receivers a harsh, raspy buzz punctuated by strong clicks or pops. The ratio of signal strength to this noise determines the quality of the carrier channel.

Carrier today is used on longer transmission circuits and on systems that resemble high-voltage distribution. Both conditions create high attenuation. More sensitive receivers would seem to be the preferred solution, but power-line noise limits usable sensitivity. The only alternative is greater transmitter power.

Typical average, quasi-peak, and peak values of noise vs frequency are shown for 69 and 138-kv lines. Data were corrected for coupling capacitor networks, input probes, and bandwidths of the noise meters. At each frequency the noise readings for each of many individual tests on that class of line were averaged together. The resultant curves are typical of the noise values found on 69 and 138-kv lines assuming about 200-ohms impedance at the point of measurement.

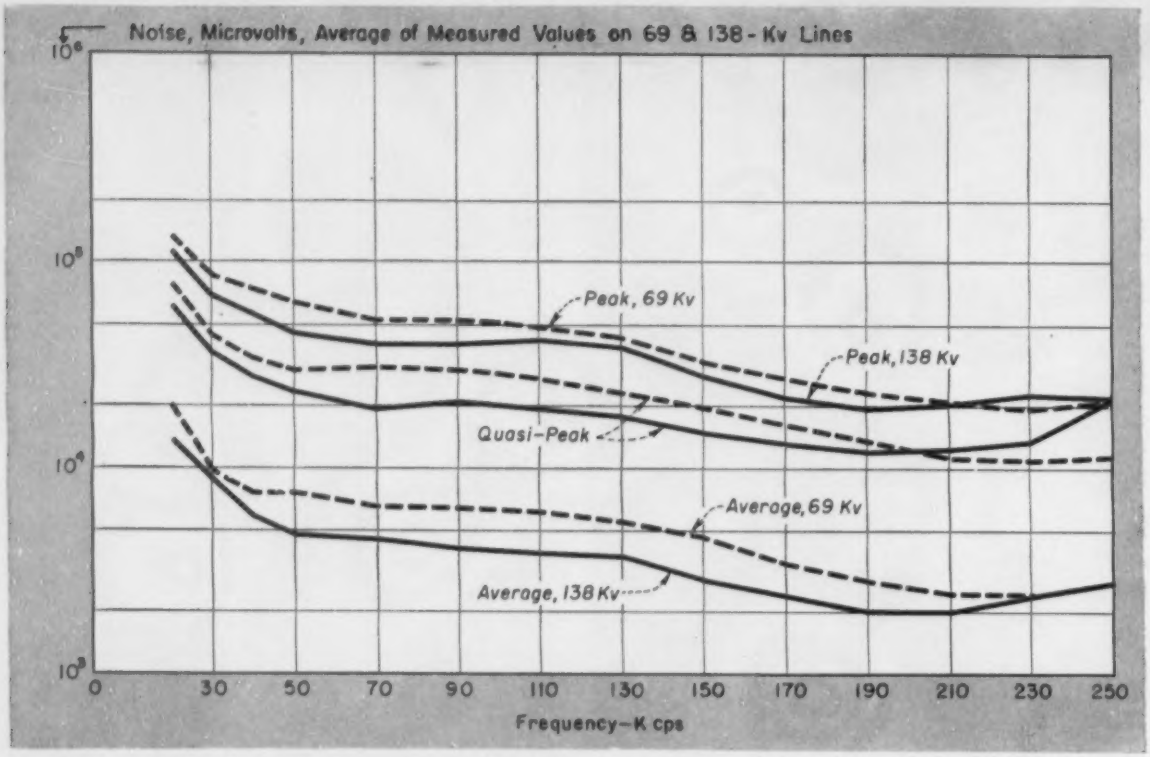
Noise from all causes can be divided into two broad classifications, impulse and random. Both are present on power lines, but tests indicate the former always predominates.

Impulse Noise . . . Impulse noise consists of sharp, discrete, well-separated pulses, each identifiable with a specific electrical discharge. It is reasonable to expect a more or less uniform repetition rate because of the cyclic nature of the power voltage that gives rise to electrical discharges on the transmission line. If the pulses are uniform and have a regular repetition rate, their spectrum contains discrete components consisting of the fundamental and harmonics of the repetition frequency.

Switch operations, faults, lightning discharges on or near the power line, and electric arcs or discharges can also produce pulses. If these are repeated at irregular intervals, they contain all the frequencies in the spectrum; and the individual frequency components vary in amplitude only gradually over a given band.

Receiver Response to Impulse Noise . . . The term "shock excitation" is often used to describe the phenomena associated with applying a sharp impulse to a selective circuit. The result is an oscillation at the circuit's natural frequency. A receiver usually contains several tuned circuits, all of which oscillate. The oscillatory voltage applied to the detector by the *nth* tuned circuit has an envelope of approximately

$$E(t) = 2A_0aG_0 \frac{e^{-at}(at)^{n-1}}{(n-1)(n-2)\dots(1)} \quad (1)$$



NOISE MEASUREMENTS FOR 69 AND 138-KV LINES are plotted here as the average of many tests. Significant to carrier applications is the broad plateu above 50 kcps. Marked similarity is shown in the variation with frequency of peak, quasi-peak, and average data

where A_o = integrated volt-time area of the original pulse

$a = R/2L = \omega f_o/Q$

G_o = overall gain of the stages at mid-band frequency f_o to which circuits are tuned

n = number of tuned circuits

Additional tuned circuits lengthen the pulse and reduce its peak value. And the peak occurs at

$$t = \frac{n-1}{a} \qquad (2)$$

The peak value of the envelope will be

$$E_{max} = 2\sqrt{2}\, A_0\, G_0\, B_0 \qquad (3)$$

where B_o = receiver frequency bandwidth and is a function of a and n in equation (1).

But the detector is normally a linear diode or a linear plate detector. The average value of its response can be determined by integrating equation (1). This gives

$$E_{av} = 2\, A_0\, G_0 \qquad (4)$$

If the pulses are repeated N times per second, provided the wave trains in the tuned circuits do not overlap appreciably, the average response is:

$$E_{av} = 2N\, A_0\, G_0 \qquad (5)$$

Average response is thus shown to be independent of bandwith.

Random Noise . . . True random noise in a communication receiver is a soft hissing or rushing sound. It can appear on carrier channels because of thermal agitation in the power-line conductors, distant atmosphere discharges or "static", or tube or resistor noise in the receivers. The almost infinite number of small discharges on an extensive power system also probably approaches random noise if considered separately from the large pulses that predominate.

Receiver Response to Random Noise . . . The characteristic of random noise is a continuous spectrum of frequencies. If the individual components have the same amplitude e at all frequencies, the rms output voltage of the receiver is:

$$E_{rms} = e\, G_0\, \sqrt{B_0} \qquad (6)$$

Peak and average values of the random noise envelope are both satistically related to the rms value, and the relationships are independent of the frequency interval. Hence they are also proportional to the square root of the bandwith. But the peak value can be defined only as a voltage that is equalled or exceeded a certain number of times during a given period.

Receiver Response to Composite Noise . . . When noise is a composite of random and impulse with neither markedly predominant, the peak receiver output can be expressed as

$$E_{max} = k_1\, B_0^{\beta} \qquad (7)$$

where β = 0.5 to 1.0 (0.75 can be assumed pending measurement).

The average value can be expressed as:

$$E_{av} = k_2\, B_0^{\gamma} \qquad (8)$$

where γ = 0.0 to 0.5 (0.25 can be assumed pending measurement).

These equations apply also to sharp impulses if repetition rate is sufficiently high to cause appreciable overlapping of wave trains in the receiver.

Quasi-Peak Value of Impulse Noise . . . Radio experience has shown that "quasi-peak" readings are approximately proportional to the masking or distracting effects of noise in aural reception of modulated signals. American Standards Association has proposed measurement with a noise meter having a detector output cir-

cuit with 0.001 sec charging and 0.60 sec discharging time constants. Readings are near the peak value for pulses occuring at a rate of approximately 15 or more per second.

The effect of impulse noise on a noise meter is to produce an indicated output in microvolts of

$$v = \frac{cE}{f_0} \times \frac{(B_0 N T_d)}{(B_0 T_c + N T_d)} \qquad (9)$$

where c = constant depending on input wave shape and gain.

E = peak value of a-c component of input.

f_0 = measurement frequency.

T_c = charging time constant of detector circuit in seconds.

T_d = discharging time constant of detector circuit in seconds.

Conversion of meter readings to standard conditions involves only the second term of this equation. Standard values of T_c and T_d are presently set at 0.001 and 0.60 sec, respectively. B_0 can be taken as 1,000 cps and N approximately 20. Then for the standard

$$\frac{B_0 N T_d}{B_0 T_c + N T_d} = 923. \qquad (10)$$

The ratio of this to the corresponding value for actual test equipment is the multiplier to convert measured microvolts to standard. But because actual noise is a composite of impulse and random, not equally affected by bandwidth, it is assumed that the composite noise varies as the 0.75 power of the bandwidth. This multiplier is raised to the 0.78 power for 200 cps bandwidth, increasing to 0.84 power for 2,000 cps.

Frequently chart recordings are made of quasi-peak noise microvolts. Then corrected maximum readings from successive 30-min. periods on the microvolt chart are tabulated. Plotting these results as the percent of time that the noise voltage exceeds given microvolt levels indicates the reliability of the channel.

Techniques of Field Measurements . . . Considerable information is necessary to define transmission line noise if measurements are to be generally useful. Random noise can be specified on the basis of its rms or its average voltage in a given bandwidth. But impulse noise requires several parameters for its definition.

Measurement of peak, quasi-peak, and average values of response with a receiver (i.e., a noise meter) of known bandwidth large enough to avoid overlapping of the pulses is required. These values can then be referred to different bandwidths, provided that the repetition rate is not great enough to cause overlapping of pulses at the new bandwidths. Thus knowledge of the pulse rate is also desirable. But it does not appear necessary to determine the original pulse amplitude or duration.

Noise levels on a power system should be investigated over the entire carrier frequency range unless proposed application is limited to a specific channel at a predetermined frequency. Measured noise can be expected to vary with the frequency at which the measurement is made because attenuation of noise components from distant sources varies with frequency like actual signals.

Weather conditions radically affect noise levels. It is desirable to record the noise level continuously at some convenient frequency over a period long enough to include a representative variety of weather conditions. The relative variation of peak, quasi-peak, and average readings under different weather conditions should also be investigated.

Field Test Procedure . . . A conventional coupling capacitor connects the noise measuring equipment to the line. Because the capacitor impedance at carrier frequencies is low, a high impedance noise meter connected across the drain coil reads essentially the actual noise voltage on the line. Testing procedure follows these steps:

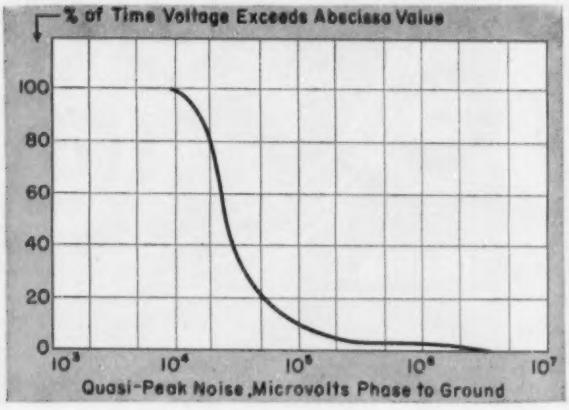
1. Calibrate noise meter shunted across drain coil with a capacitor in series equal to the coupling capacitor to check voltage-dividing properties at each frequency.

2. Measure during clear weather the peak, quasi-peak, and average noise voltages at frequent intervals throughout the power-line carrier spectrum. Listening tests guide selection of frequencies free of interfering signals.

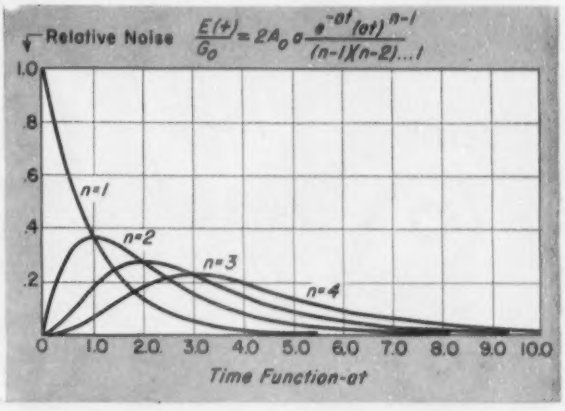
3. Set noise meter to a convenient frequency clear of interfering signals and record quasi-peak noise continuously. Recording period must be long enough to include a variety of weather and regularly performed switching operations, which should be logged for proper correlation.

4. Check calibration regularly during recording period and at end.

5. Correct data to standard bandwidth or to bandwidth of carrier equipment already selected for the channel.



QUASI-PEAK NOISE READINGS are plotted as percent time that noise exceeds abscissa microvolts to predict reliability of channel



ADDITIONAL TUNED CIRCUITS in carrier receiver reduce response to noise pulses provided lengthened wave trains do not overlap

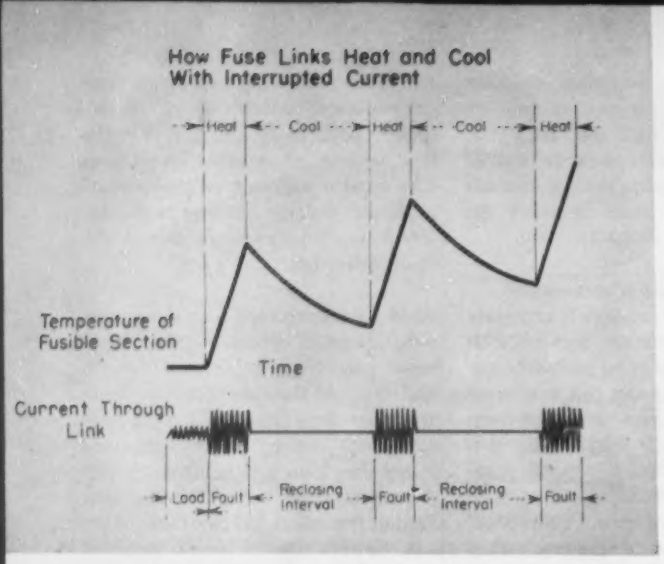


FIG 1—FUSE LINKS go through a heating and cooling cycle when operating in series with the reclosers on distribution circuits

How Do Reclosers

R. E. RIEBS, Assistant Engineer, Development Section
R. H. AMUNDSEN, Design Engineer,
Line Material Co, Milwaukee

Tests measure fuse link temperatures and establish heating and cooling curves which determine performance of fuses under any set of recloser operating conditions

To improve methods of coordinating oil reclosers and fuse links, investigations have been made to determine the exact manner in which a tin fuse link behaves when it is subjected to a series of repeated faults.

When such a fuse is subjected to a current large enough to melt the tin, there is a period of temperature rise and then fusion of the link at constant melting temperature. When the current flowing through the link is interrupted periodically, as when a link is in series with a recloser, the fusible section is heated and cooled periodically as shown in Fig. 1. To predict whether the link will melt requires a knowledge of its heating and cooling curves.

To aid this study a method of measuring the temperature of a link during the melting process was developed. Heating and cooling curves for a typical fuse link without preloading were obtained, Fig. 2.

Predict Fuse Behavior . . . These curves can be used to predict the behavior of a fuse link subjected to repeated

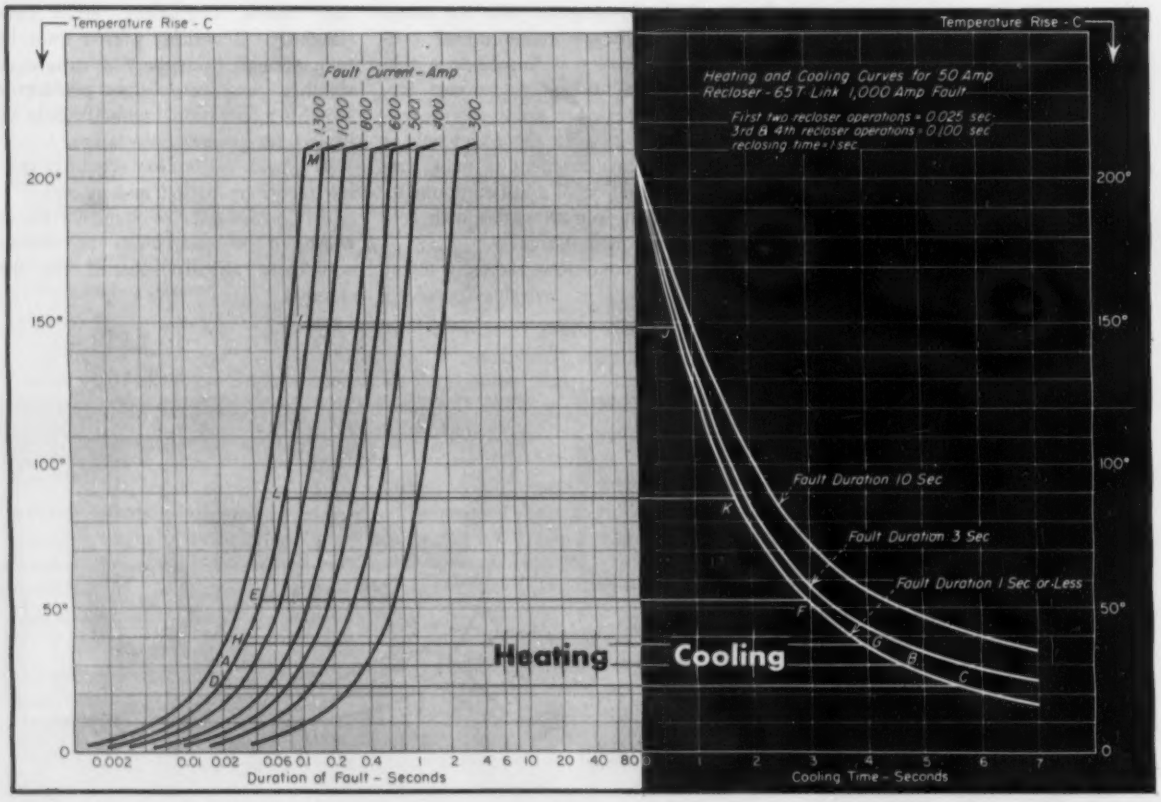


FIG 2—FUSIBLE ELEMENT TEMPERATURES of fuse links were measured and the results are shown here for 65 T-type link operating in series with a 50-amp recloser. To find if a fuse will blow during recloser operations, trace temperature changes through cycle

Affect Fuse Link Performance?

faults encountered when it is coordinated with an oil circuit recloser.

Illustrating by an example: Assume that we wish to determine whether a 65-amp, Type-T link will be destroyed when a lightly-loaded 50-amp recloser on the load side of the fuse encounters a 1,000-amp fault, at 20C ambient. The recloser will operate four times for 0.025, 0.025, 0.10 and 0.10 sec with one second reclosing time.

First interruption of the recloser occurs after 0.025 sec. During this interval, the link temperature rises 30C to point A on the 1,000-amp heating curve. During the subsequent one-second reclosing interval, the link cools from point B to point C. The latter point indicates link temperature at the start of the next reclosure. This temperature represents an Equivalent Heating Time (EHT) of 0.019 sec for the first shot and reclosing interval and is Point D on the heating curve.

Second operation of the recloser raises the temperature to E, which is 0.025 sec farther up the heating curve. This temperature, 53C, on the cooling curve is F. Allowing one second to cool, brings us to G, the temperature at the start of the third recloser operation. This temperature, H on the heating curve, gives an EHT of 0.032 sec for the first two operations. Time of the third operation, 0.10 sec, is now added to the EHT of the first two operations and I is reached.

A one-second reclosing interval carries the link temperature from J to K. And L., 0.075 sec, is the EHT of the first three opening and reclosing operations. The fourth operation of 0.10 sec brings the link to M just below the melting temperature. No damage has been done by this sequence.

Determine Other Curves . . . Although these heating curves are plotted to maximum values of a 65-amp, Type-T tin link, their usefulness lies chiefly in establishing the shape of the heating curve for a fuse link of this type. When heating of another link size or type is to be investigated, an overlay is placed on the curves of Fig 2, and end points are plotted from the time current characteristic for the particular fuse link at maximum or minimum melting time.

From those end points, heating curves are drawn-in following the shape of the 65-amp curves. Excellent results have been obtained for fuse sizes down to 20 amp

(*Continued on page* 163)

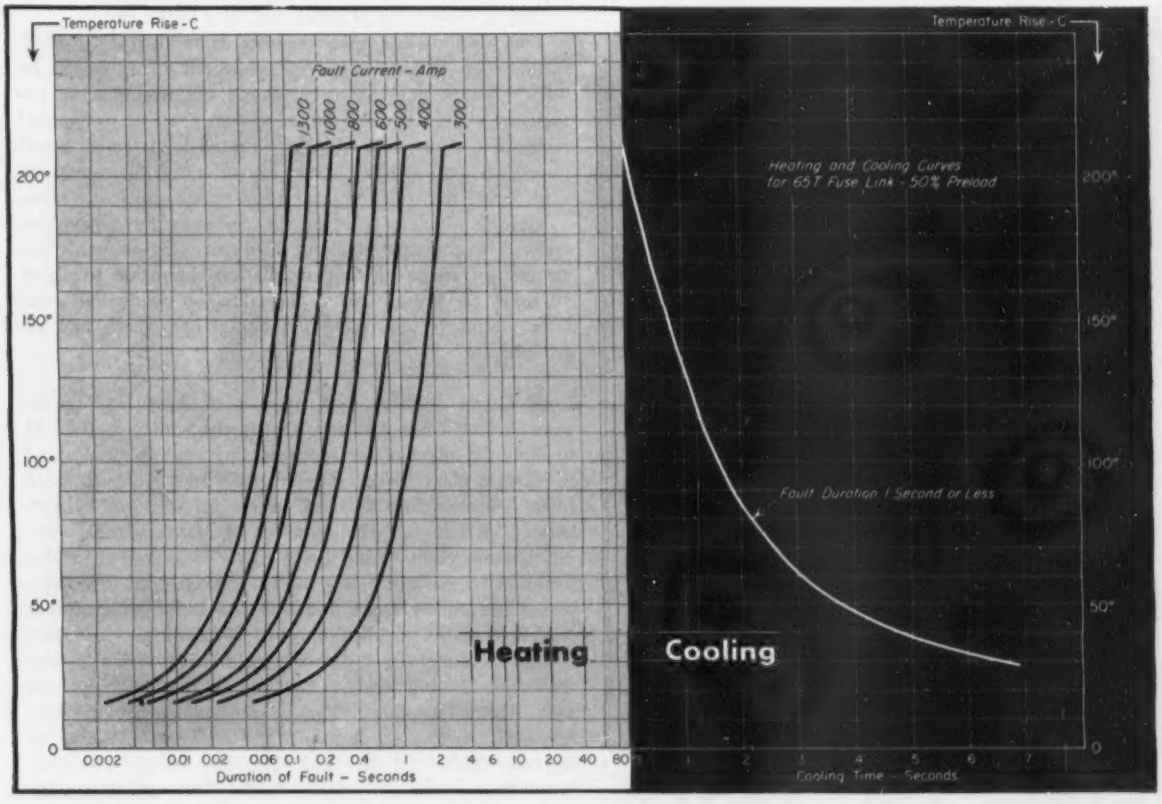


FIG 3—EFFECT OF PRELOADING fuse link can also be determined by the following heating and cooling sequence on curves based on fuse temperature created by preloading, in this case a 65 T-type link and 50% preload. Similar curves for other link sizes can be drawn

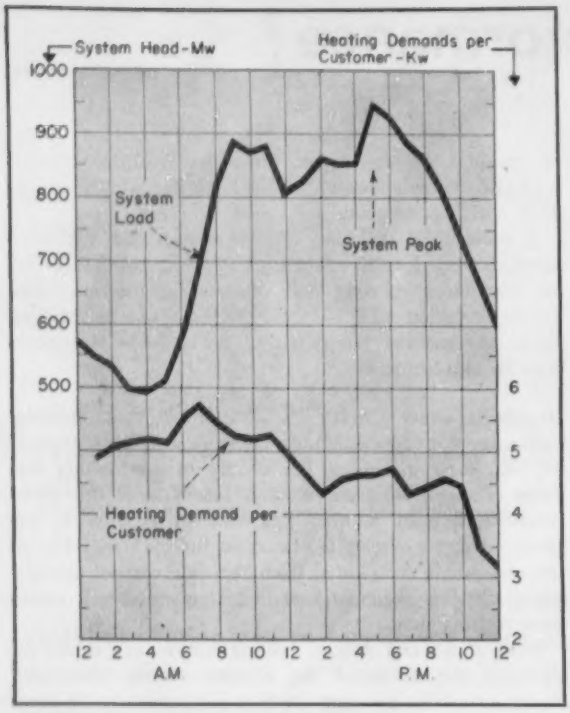


CHART 1—PEAK-DAY SYSTEM LOAD compared with the average space heating demand in kw per customer on the same day. Note heating demand peaks at 5.75 kw at 7 AM but drops to 4.7 kw at 5 PM when the system peak is reached

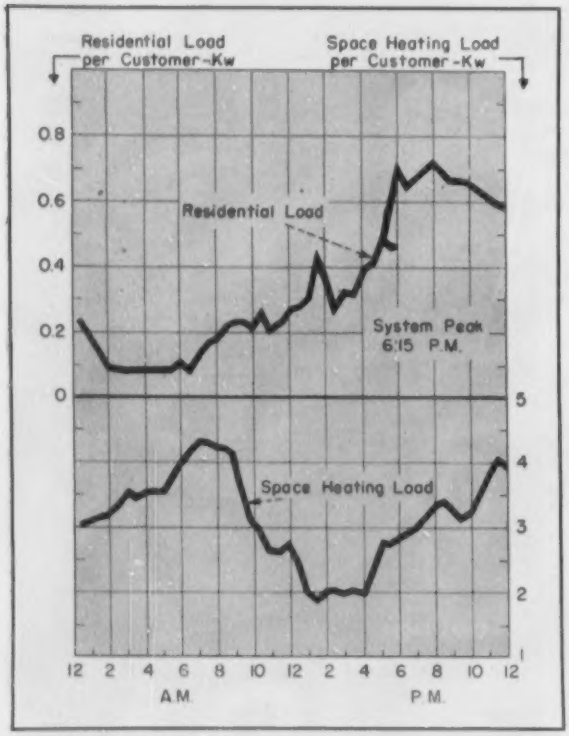


CHART 2—LOAD CURVE of average-usage non-heating customer compared with average space-heating load per customer on day of residential class peak. Heating is shown to be largely complementary to other kinds of residential load

Electric house heating . . .

It Flattens Curve

Characteristic of the electric house heating load is a definite morning peak. The effect of this peak will be to improve the shape of the residential class load curve as the number of heating customers rises to as high as 10% or more of the class total. The highest demand of the heating load is not likely to coincide with either the peak of system load or that of residential load. And, obviously, a small percentage increase in number of heating installations will cause a large percentage increase in volume of residential energy sales.

These conclusions are drawn from data collected by the Union Electric Co of Missouri, and they are specific to the climatic conditions of the company's service area.

Effect of Heating Load . . . Data reported for the Union Electric Co of Missouri to Aug. 31, 1953, indicated there were 544 complete and 466 auxiliary heating installations in its service area. These represented saturations of 1/9 and 1/10 of one percent, respectively, referred to the 468,002 residential customers (as of Aug. 31, 1953). A 1% saturation, or 4,680 complete installations at the present average of 7.42 kw each, plus a 1½% saturation, or 7,020 auxiliary installations at 2.09 kw each, would add a total of 49,400 kw of connected load to the system.

The simultaneous space heating demand, using a 90% coincidence factor based on connected load, would be 44,500 kw, which, however, would not normally be coincident with either the winter system peak or the annual residential class peak. At 20% annual load factor, based on coincident demand, some 78 million kwhr would be sold, equal to 7.6% of total 1952 residential kwhr sales.

Residential class sales of the company have been increasing at the rate of about 12% per year—thus, if the number of space heating installations increases to about 14 times the present value, the effect on residential kwhr sales would be equivalent to about one year's normal growth.

Load Curve Data . . . A number of daily load curves were derived from data recorded in the winter of 1950-51 to show the effect of the space heating load on system and residential class loads. The heating data were obtained from G9 recording demand meters installed on 7 space heating customers. The data for residential loads without heating came from a G9 meter installed on a distribution transformer serving 35 residential customers whose use during December was 188 kwhr per customer compared with a system average of 182 kwhr per customer.

Chart 1 compares the total system load with the electric space heating load on the day of the winter system peak, Dec. 19, 1950. The space heating curve peaks around 7 AM when system loads are just beginning to increase. This load averaged about 4.7 kw per customer at the time of the system peak (5:20 PM), which is 82% of the day's peak of 5.75 kw and 70% of the seasonal maximum coincident demand of 6.76 kw per customer.

# of Residential Load

Chart 2 compares the residential class load with the electric space heating load on the day of the residential class peak, Dec. 31, 1950. The space heating load averaged 3.34 kw at the time of the residential class peak (8 PM), or 49% of the seasonal maximum coincident demand of 6.76 kw, which occurred on the following January 30.

As, in 1950, Dec. 31 occurred on Sunday, it was felt that the residential load curve observed on that day was not typical of that to be expected in a normal year. Therefore, the daily load curves of six weekdays before and after Dec. 31 were averaged to form an average weekday residential load curve which would be more likely to occur on a Dec. 31 which was a "normal" weekday.

Chart 3 compares this derived curve with the Dec. 31 space heating curve. The residential peak occurred at 7:30 PM, and the space heating load at this time was 3.18 kw (per customer), or 47% of the seasonal maximum coincident demand.

Chart 4 compares the residential class load with the electric space heating load for the average weekday of the coldest week of the 1950-51 heating season (Jan. 29-Feb. 2). The residential peak occurs at 8 PM, and the space heating load at this time is 5.25 kw (per customer), or 78% of the seasonal maximum coincident demand. If the coldest day were coincident with the day of the residential class peak (Dec. 31), it might be considered that space heating would add 5.25 kw of diversified demand per space heating customer to the residential class peak.

Chart 5 was developed to show the effect of various saturations of electric space heating upon the basic residential load curve. To the basic residential load curve for the average weekday of the coldest week (which is similar to the average weekday curve developed on Chart 3, which is assumed to be representative of a normal year Dec. 31 residential load curve) were added increments proportional to various saturations of electric space heating. It is evident from the curves that the shape of the residential load curve remains essentially the same for saturations up to 10%, the daily peak occurring at 7:30 or 8 PM.

Temperature Conditions . . . Obviously, the contribution of electric space heating to the residential class peak is of major importance. The figure of 5.25 kw (Chart 4) represents a combination of the most unfavorable factors possible—It is the average space heating demand at 8 PM, occurring during the coldest week of the heating season, the average daily mean temperature being 5.4 F, which is colder than would normally be expected.

The 1950-51 heating season space heating contribution to the residential class peak is based on the space heating load curve metered on Dec. 31, 1950 (Chart 3) and the actual metered demand at 7:30 PM which was 3.18 kw. The mean temperature for the day was 35 deg F, compared to the normal mean temperature for Dec. 31 of 34 deg F. The value of coincident demand obtained, 3.18 kw, is felt

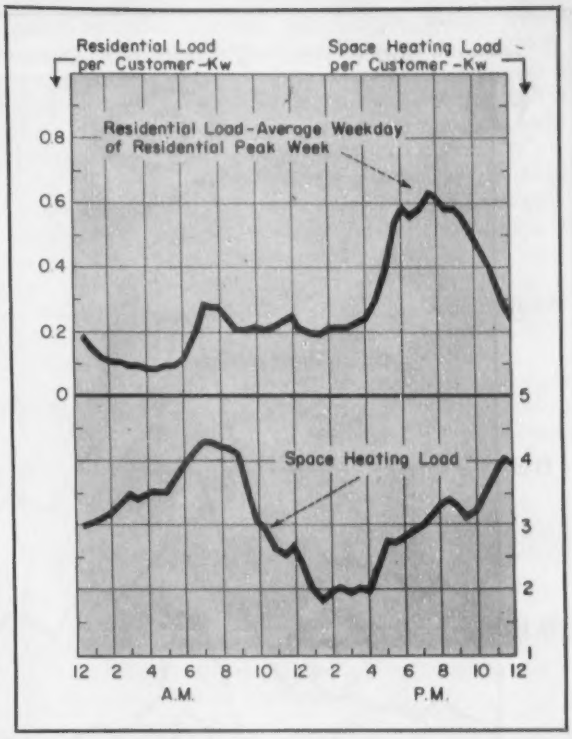


CHART 3—AVERAGE WEEKDAY LOAD per customer during week of highest residential load compared with average space-heating load per customer on day of residential load peak. At the time of the residential peak, heating load was 3.18 kw

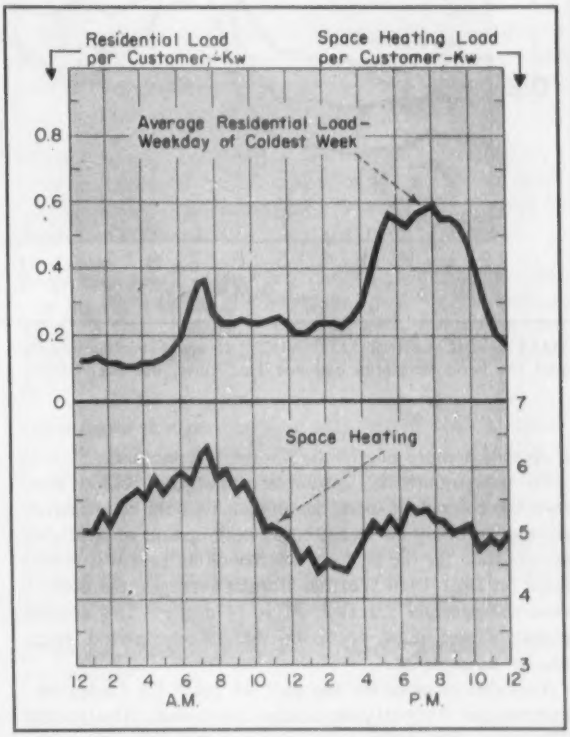


CHART 4—AVERAGE LOAD per customer during the coldest week of 1951 (Jan. 29-Feb. 2) compared with average heating load in the same week. Residential peak occurred at 8 PM when space heating load was 5.25 kw, rising from the day's low of 4.4 kw

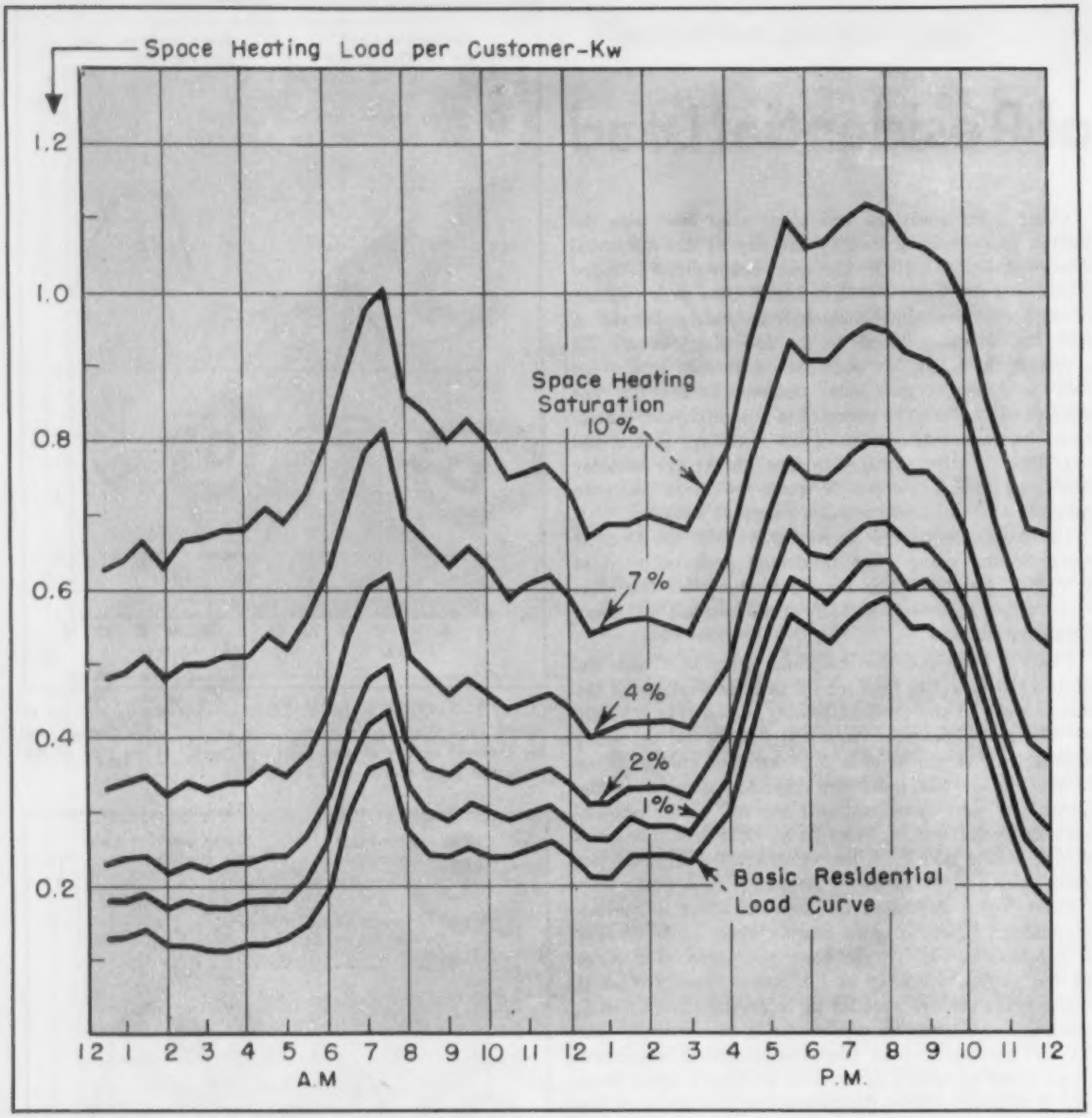


CHART 5—INCREASING SATURATION of space heating rapidly raises the basic residential customer load curve. But the morning peak caused by space heating remains below the evening peak through the early period of increase, up to something above 10% saturation

to approach more nearly the "normal" condition.

To substantiate the assumption that the coldest day, when the coincident space heating peak would be expected, will not normally be Dec. 31, an examination of available weather data for the St. Louis metropolitan area was made. Based on 1921-1950 Weather Bureau averages, the normal mean temperature for Dec. 31 is 34 deg F. The normal coldest winter days occur in the 12-day period from Jan. 11 through 22.

Available records for the past 43 years for December, January and February were also examined. The lowest daily mean temperature for each of these three months was obtained for each of the past 43 years.

A brief summary of the data obtained from 1910-1953 records follows:

	December	January	February	3 Month
Range of lowest daily mean temp.—deg F	0 to 35	—8 to 29	—1 to 29	—8 to 20
Average of lowest daily mean temp.—deg F	15.6	10.3	16.5	6.8
No. of times lowest daily mean temp. in 3-mo. period occurred in mo.	8	27	10	—

It is evident from these data that the lowest daily temperature of the three month period occurred in December 8 times, January 27 times, and February 10 times in the 43 year period. In other words, the coldest day of any heating season will fall most often in January and is even more likely to occur in February than in December. Not once in the entire 43 year period did the coldest day of the heating season fall on Dec. 31.

WASHINGTON COMMENT

JESSE MOCK

The Eisenhower budget submitted to Congress last month is as much a challenge to the electric power industry as those drawn up by Democratic administrations in the past.

There is this significant difference: the Republican budget is a bid for electric companies to assume a greater responsibility for meeting the nation's power needs. Past Democratic regimes have stressed and charted a larger federal role in power development and marketing.

GOP Holds Out A Challenge To the Utilities

Melodrama aside, this could be the most promising opportunity the industry will have in a long time to show its willingness to do the job. Local and state publicly owned utilities have a share in this, too, as the Eisenhower message emphasized.

In effect, the budget message said the federal government is no longer going to use financial and tax advantages to change power marketing patterns in local areas. As much as possible, it will look to local interests to develop water power sites and provide necessary transmission facilities.

Already non-federal utilities are showing a renewed interest in hydroelectric development. You can see that from the applications filed with Federal Power Commission during the last six months looking toward power developments in the Southeast, the West and the Pacific Northwest. More are expected along with the rapid and continuous expansion of steam-electric generation.

However, with regard to transmission, things are going more slowly. Wheeling, transmission or delivery contracts for southeastern and southwestern areas were pending when the Eisenhower Administration took over in January of last year. They are still pending, with indications that some ground has been lost, as this is written. More problems involving transmission of government-produced power are sure to crop up this year.

This delay isn't helping either the present Administration or the electric companies involved. It cannot help but reflect on the Administration's ability to handle delicate power matters.

It is not much justification to point out that some of these same problems were kicked around for years by former Democratic Administrations and never solved. There is a lot more pressure now for a solution because the power is actually being produced at government plants and being disposed of through temporary contacts.

In volume and capacity, neither of these transmission problems loom large, but there are enough Republican Congressmen from the affected areas to give the GOP its present house majority. Thus the political consequence of a solution cannot be discounted.

The challenge of the budget is much broader than the few areas where power problems are immediate and worrisome. Electric companies throughout the nation must be ready to step in as the federal role changes.

The continuing "no new start" policy for federal power projects is bound to cause a sizable shift of plans, especially for preference customers. Those that have been counting on a constantly expanding federal generation program to fill their needs will have to turn elsewhere.

In the Missouri River Basin, for instance, preference customers estimate they will need some 523,000 kw of capacity by 1956, although only 325,000 kw of federal capacity is to be available by that time.

Electric companies will have to come in and serve a share of this expanding load, if the Administration plan is to be implemented. Local public power groups and co-ops will take part of it, too.

It will take more than short-range business evaluations to make some of the moves required by the budget challenge. What is needed now, the Administration feels, is industrial and political statesmanship along with a potent amount of salesmanship.

Those who set GOP power policy hold that the opportunity is not, as federal power advocates contend, the offer of a giant bonanza for the private utilities.

It is an opportunity, they say, to show that private enterprise can and will supply the nation's power needs at reasonable rates and with a sincere regard to the public interest.

TECHNICAL NOTES

ARCHER E. KNOWLTON

On 15 kv class distribution circuits, the conductivity of a fully-creosoted pole is too high for linemen to be safe in the event of accidental wire contact.

Line interruptions decrease after installing line expulsion arresters—81% in 13-35.5 kv range, 75% in the 44-69 kv and 66% in the 100-138 kv. For comparable protection, AIEE report says the tubes cost 1.1 to 1.3 times as much as overhead ground wire.

Additional back-up relaying is not needed for a generator if all elements of the connected system have primary and back-up protection to clear any fault before the I_s^2t capability of the machine is exceeded.

Steels presently available for transformer cores have magnetic characteristics which make them desirable for operation at flux densities considerably above those dictated for very low noise levels.

Surge impedance loading for divided-conductor transmission lines will be 25 to 30% higher than for conventional 60-cycle single-conductor lines. At surge impedance loading the kvar loss is substantially equal to the line-charging kvar.

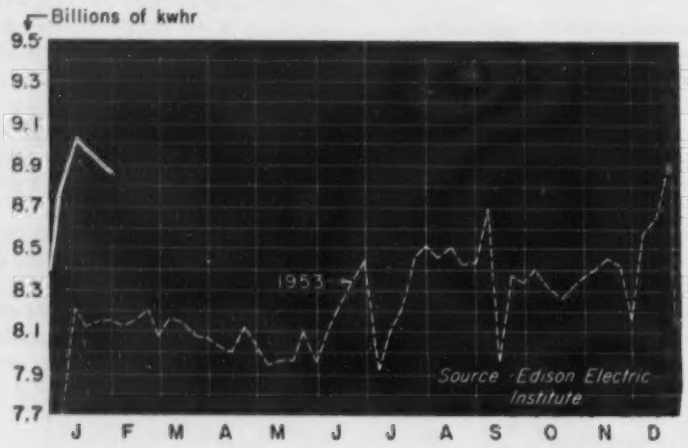
Germanium was predicted by Mendelejeff (1873), discovered by Winkler (1886) and found at Purdue (1942) to have valuable properties as a semi-conductor. It is found in flyash and is worth $350 a pound.

Xenon 135 is the most important "poison" developed as a by-product of uranium fission because it has a capture cross-section greater than any other known nucleus.

Employee found unconscious turned out also to be safety-unconscious.

Steel pipe both strengthens and distorts the magnetic field surrounding an enclosed energized cable. The increase in excess of a.c. over d.c. loss in conductor may be as much as 100% and a similar increase in shield-assembly loss.

STATISTICS



Output Week Ended Jan. 30—8,855,000,000 Kwhr

Seasonally Adjusted Index†—161.3

Per Cent Change From Previous Year

	Total US	New Eng.	Mid. Atlan.	Cent. Ind.	West Cent.	South-east	South Cent.	Rocky Mount.	Pacific NW	Pacific SW
Jan. 30	+8.6	+5.9	+3.5	+1.5	+11.5	+18.7	+10.7	+9.3	+21.6	+8.3
Jan. 23	+10.2	+6.5	+5.5	+2.5	+11.9	+21.3	+8.1	+9.6	+30.6	+9.4
Jan. 16	+11.0	+7.4	+6.9	+3.0	+10.1	+22.2	+8.9	+11.0	+31.1	+11.4

Electric Power Statistics

		Latest Month	Preceding Month	Year Ago
Peak Load (Million Kw)	Dec.	80.9	78.1	75.2
Capacity (Million Kw)	Nov.	89.81	88.62	80.91
Production (Billion Kwhr)	Nov.	36.38	37.61	33.78
Hydro	Nov.	6.91	7.14	6.52
Fuel	Nov.	29.47	30.48	27.25
Fuel Consumption				
Coal (Million Tons)	Nov.	10.17	10.22	9.95
Oil (Million Barrels)	Nov.	6.91	6.78	7.77
Gas (Billion Cu Ft)	Nov.	81.13	96.85	69.17
Sales (Billion Kwhr)	Nov.	31.59	32.21	30.08
Residential	Nov.	9.02	8.70	8.16
Commercial	Nov.	5.50	5.62	5.01
Industrial	Nov.	14.95	15.56	14.91
Other	Nov.	2.12	2.33	2.01
Net Income Class A & B Companies ($ Million)	Nov.	84.99*	76.19	80.63
Estimated Dec. '54 Peak (Million Kw)	Oct.	94.8	95.0	95.7
Kwhr per Residential Customer (12 Month Average)	Nov.	2,331	2,318	2,155
Revenue per Kwhr Residential Service (12 Month Average)	Nov.	2.75¢	2.75¢	2.77¢
Canadian Production (Billion Kwhr)	Nov.	5.45	5.51	5.22

Business Statistics

FRB Industrial Production Index†	Dec.	125*	130	131
Gross National Product Annual Rate ($ Billion)	3rd Qtr.	369.0	372.4	345.3
EW 4 Industry Production Index†	Dec.	120.4	121.8	125.9
ENR Construction Cost Index††	Jan.	128.7	128.2	123.1
BLS Consumer's Price Index	Dec.	114.9	115.0	114.1
NEMA Insulation Materials Sales Index†	Nov.	130	154	155
NEMA Electric Appliance Sales Index†	Nov.	70	91	100
NEMA Household Refrig. Sales Index†	Nov.	35	46	77
Metal Prices (Feb. 2)				
Copper, Conn. V., lb		$.29½-.30	.29½-.30	.24¼
Lead, N. Y., lb		.13	.13½	.13½
Zinc, prime Western E. St. Louis, lb		.09½	.10	.12
Tin, Straits, qual. N. Y. lb		.85	.85	1.21½
Aluminum, ingot, base price		.21½	.21½	.20½
Nickel, base price		.60	.60	.60
Steel, billets, Pitts., ton		62.00	62.00	59.00
Steel, scrap, No. 1 heavy, Pitts., ton		30.00	31.00	45.00

* Preliminary ** Revised † 1947-49=100 †† 1949=100

Business in the U.S. Gets a Census Count

Businesses, like people, get counted at periodic intervals, and the trends and growth patterns of the business population are as illuminating in terms of the whole economy as are the long range effects of changes in the human population. The counting job is an undertaking of the Dep't of Commerce, which recently has issued data as of mid-1953.

At that time, the number of firms in operation was over four million. The bulk of these were very small—¾ with fewer than 4 employees, while less than 2% employed 50 or more people. The leading sector was retail trade, which accounted for 45% of the total number of firms. The service industries (hotels, movies, etc) were the next largest with 18% of the total. The transportation group, which includes public utilities, represents 4% of the total.

Number of Firms in Operation

(000's)

	June 30 1953
All Industries	4,212.4
Mining	37.9
Contract Construction	433.8
Manufacturing	328.2
Transportation	185.7
Wholesale Trade	284.8
Retail Trade	1,864.1
Finance & Real Estate	338.0
Service Industries	739.8

The statistics collected refer to the entire private economy, except for the fields of agriculture and professional services. In the remainder all firms are included, each classified according to its major activity, and counted once in the total.

The war naturally produced a growth stoppage in most fields, except manufacturing. Thereafter, the number of firms increased very rapidly, from slightly over three million in 1945 to slightly under four million in 1948, with about half that increase all in 1946.

Currently, the largest increases since prewar have been in the retail appliance and radio fields, in which the number of firms has practically tripled. Since 1948, however, the business population having largely compensated for the wartime "deficit," has been levelling off, with little increase in the actual number of firms in operation.

Pepco Rate Case Remanded . . .

. . . to PUC by District court. Suit involves Capital Transit, whose share of utility's $2.6-million hike is $230,000

The Circuit Court of Appeals of the District of Columbia has remanded to the Public Utilities Commission of the District of Columbia, for a rehearing the Potomac Electric Power Co rate case which affects the Capital Transit Co.

Pepco was originally granted by the PUC a $2.6 million annual rate increase of which Capital's share was $230,000. The PUC in its initial action denied Capital's petition for a rehearing. A subsequent action in the District Court was dismissed whereupon Capital appealed to the Circuit Court.

Failed to Segregate Costs . . . The principal contention of Capital was that the PUC in arriving at the proposed rate increase, did not segregate either property or operating costs as between the four jurisdictions in which Pepco operates, but based its rate increase on an evaluation of total system properties, rate of return and then—"approved, for the District alone, rate schedules which, as applied throughout the system, would net the required revenues."

Capital contends that "the rates fixed for the District cannot be said to be 'reasonable, just, and nondiscriminatory', the standards prescribed by the local statute."

Both the PUC and Pepco have contended that the highly integrated character of the company, subject as it is to four regulatory jurisdictions, makes any segregation of property costs and revenues extremely difficult.

The court said: "In these circumstances it is not always essential in fixing rates for District consumers to segregate properties, costs or revenues merely because the total properties and services of the power company extend to other jurisdictions. This conclusion has involved our consideration of decisions of the Supreme Court and of this court relied upon by Transit to the contrary."

Cites Similar Case . . . In a closely reasoned analysis of cases relied upon by the transit company to substantiate its case, the court, discussing the Smyth vs Ames decision, said—"To avoid discrimination by the rates of one jurisdiction against those of another—to establish the reasonableness of the intrastate rates to be approved —separation of the property, costs and business involved in the intrastate business was deemed necessary. This purpose has led to the statement that allocation is essential to the appropriate recognition of state and federal authority."

In its analysis of the case of the Illinois Commerce Commission vs United States, the court said—"(the) Court (i.e. Supreme Court) [emphasis supplied] was reviewing an order of the Interstate Commerce Commission directed at removal of unjust discrimination against interstate commerce due to disparity of the intrastate and interstate switching rates of interstate carriers in the Chicago Switching District. The court said that where conditions are found to be substantially the same as to all features bearing on the reasonableness of the rate, and the interstate and intrastate classes of traffic are shown to be intimately bound together, separation of interstate and intrastate costs and revenues is not required."

The court further said: "By reason of the foregoing it seems plain that at least certain steps taken by the commission on the basis of the system-wide operations of the well integrated power company without allocation of its properties, costs or revenues, withstand attack."

While the court, up to this point, was not in disagreement with the position taken by the PUC in its system-wide approach, it said significantly "We reach this point in the process followed by the commission without finding error in the system-wide method pursued. This leaves undetermined, however, the validity of rates actually approved for District consumers. Here the problem which gave rise to the allocation requirement remains even though that formula may not be the only route to its solution. We must be able to say that the rates in the District are reasonable, just and nondiscriminatory as a part of, or in relation to, the system rates contained in the schedules of the power company for areas and services beyond the commission's jurisdiction; that is to say, that District consumers do not subsidize the non-District, or indeed, vice versa."

PUC Must Offer Evidence . . . The court continued ". . . the commission must make findings, with supporting evidence, which disclose a rational basis for those rates which it approves as part of broader schedules which apply beyond its jurisdiction."

That the court was unable to satisfy itself on this important point is witnessed by the following quote from Judge Fahy's opinion when he said ". . . where economic conditions in the areas served are found to be substantially the same with respect to all features bearing on the reasonableness of the rate and the areas are shown to be intimately bound together there is no occasion to separate costs and revenues according to jurisdictional lines. But the evidence and findings must bring this situation within these tests if they are to apply."

Judge Fahy continued—"With respect to the suburban business, the power company with the approval of the Maryland commission applies a higher rate there than in the urban zone, due to higher costs, but there is no finding the suburban rate bears such relationship to higher costs as, considered from the standpoint of costs alone or together with other factors the commission might deem to be relevant, enables us to arrive at a judgment that the District rates are reasonable in this still larger context of system-wide rates."

The opinion concluded: "The burden upon Transit to sustain its attack upon the orders is carried when such findings, essential to adequate review, are lacking."

Backs PUC Findings . . . While Judge Fahy found that as to the rate of return, the commission's findings were ". . . not unreasonable, arbitrary, or capricious, or so unsupported by evidence as to be legally inadequate."

As to the amount of the rate in-

crease assigned to Capital the court agreed that ". . . the findings presently before us are not adequate in respect of the increase assigned to Transit by the orders now under review."

Chief Judge Stephens, while agreeing with Judge Fahy on the matter of District rates, disagreed with him as to the adequacy of the commission's findings on the rate of return. He went on to say that ". . . I am also of the view that the discussion of the commission on the issue as to the amount of the total rate increase to be apportioned to Transit fails to satisfy the requirements of the courts for findings."

Judge Stephens quoted extensively from the court's requirements laid down in the Washington Gas Light case as to the necessary criteria to be considered by the commission in arriving at the allowable rate of return.

Again referring to the gas case, Judge Stephens said ". . . this court dealt also with another requirement. It appeared in that case that the commission in deciding upon a rate of return had relied upon a finding made on that issue in a prior proceeding involving the same utility."

Judge Stephen's quote from that record reads " 'There is nothing before us to indicate that pertinent local conditions and economic conditions generally have remained static during the intervening years. Nor does it appear that the risk factor, so important an element in fixing rate or return, has remained static.' "

Judge Stephens continued: ". . . if the commission has relied upon a rate of return determined in a previous proceeding involving the same utility, a further finding upon the question whether or not pertinent local conditions, economic conditions generally, and the risk factor have remained static during the intervening period." He also said—"The 'expertise' of a commission usefully serves it in evaluating the evidence, but that expertise cannot supply evidence and cannot, without findings made upon the critical issues before it, guide a commission to a rational and lawful decision."

As to the amount of the total rate increase to be apportioned to the appellant, Judge Stephens said in his conclusion "In my view, the whole of the discussion of the commission and all of its allusions to evidence, whether in its opinion and Order No. 3762 or in the brief of the commission and

(*Continued on page* 160)

Today in Utility Finance

YIELDS (%)

Quality	Bonds			Preferred Stocks			Common Stocks		
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
DATE 1954									
Jan. 28	**2.94**	**2.99**	**3.21**	**4.06**	**4.17**	**4.51**	**4.94**	**5.40**	**5.41**
Jan. 21	2.97	3.02	3.21	4.08	4.15	4.55	4.96	5.42	5.43
END OF QTR.									
4th 1953	3.07	3.12	3.34	4.17	4.32	4.62	5.07	5.57	5.51
3rd 1953	3.30	3.33	3.54	4.35	4.52	4.83	5.36	5.97	6.01
2nd 1953	3.34	3.46	3.64	4.47	4.70	4.88	5.52	5.93	6.10
1st 1953	3.15	3.23	3.39	4.16	4.41	4.66	4.95	5.24	5.50

Data: Reis & Chandler, Inc.

EARNINGS

Company	Period Months Ended		Net Income 1953	Net Income 1952	Earnings Per Common Share 1953	Earnings Per Common Share 1952
Arkansas Power & Light	12	Dec.*	$6,293,598	$5,696,602	$....	$....
Bangor Hydro-Electric	12	Dec.*	919,297	772,852	2.06	1.87
Mountain States Power	12	Nov.	1,825,497	1,601,578	....	....
New York State Electric & Gas	12	Dec.*	9,053,537	7,477,155	2.55(a)	2.38(a)

NOTES—* Subject to the year-end audit; (a) Based on 3,034,068 shares in 1953 and 2,696,250 shares in 1952.

FINANCING

Company and Description	Amount of Offering (000)	Offering Price	Yield to Public
WEEK OF JANUARY 28—FEBRUARY 3			
Bonds			
British Columbia Electric—1st mtg 4¾% due 1979	$15,000	99.50%	4.78%
Preferred Stock			
Mississippi Power & Light—60,000 sh 4.36% $100 par	$6,000	$101.86	4.28%
Common Stock			
Southwestern Public Service—272,500 sh (being offered commonholders on a 1-for-14 basis, record Feb. 1 to expire Feb. 16 with an oversubscription privilege)	$6,131	$22.50	5.87%
SCHEDULE FOR FEBRUARY—MARCH—APRIL—MAY			
Bonds			**Bid Date**
Public Service Co of Oklahoma—1st mtg due 1984	$12,500	.....	Feb. 8
Louisville Gas & Electric—1st mtg due 1984	12,000	.....	Feb. 9
Pacific Gas & Electric—1st mtg due 1984	60,000	.....	Feb. 16
Essex County Electric—1st mtg due 1984	5,000	.....	Feb. 17
Houston Lighting & Power—1st mtg due 1989	30,000	.....	Mar. 1
Suburban Electric—1st mtg due 1984	4,000	.....	Mar. 3
Alabama Power—1st mtg due 1984	17,000	.....	Mar. 16
San Diego Gas & Electric—1st mtg due 1984	17,000	.....	Mar. 30
Georgia Power—1st mtg due 1984	11,000	.....	April 6
West Penn Power—1st mtg due 1984	12,000	.....	April 20
Utah Power & Light—1st mtg due 1984	15,000	.....	May 19
Community Public Service—1st mtg due 1984	3,000	.....	.....
Atlantic City Electric—1st mtg due 1984	5,000	.....	.....
El Paso Electric—1st mtg due 1984	5,000	.....	.....
Preferred Stock			
El Paso Electric—15,000 sh no par	$.....	.....	.....
Common Stock			
Missouri Public Service—527,865 sh (to be offered commonholders on a sh-for-sh basis, record about Feb. 4)	.....	.....	.....
Utah Power & Light—200,000 sh	.....	.....	Mar. 23
Black Hills Power & Light—14,100 sh (to be offered to commonholders)	.....	.....	.....
Southern Indiana Gas & Electric—114,166 sh (to be offered commonholders on a 1-for-7 basis)	.....	.....	.....
South Carolina Electric—286,436 sh (to be offered commonholders on 1-for-10 basis, record Feb. 17; additional subscription privilege and rights for holders of less than 10 shares)	.....	.....	.....
Southern California Edison—600,000 sh	.....	.....	.....
Atlantic City Electric—151,672 sh	.....	.....	.....
El Paso Electric—76,399 sh (to be offered commonholders on 1-for-10 basis)	.....	.....	.....
POSTPONED, UNSCHEDULED, AND/OR UNDER CONSIDERATION			
Bonds			
Public Service Co of Colorado—1st mtg	$15,000	.....	.....
Brazos River Authority, Tex.—electric revenues	66,000	.....	.....
Jersey Central Power & Light—1st mtg	6,000(e)	.....	.....
Pennsylvania Electric—1st mtg	12,500(e)	.....	.....
Florida Power & Light—1st mtg	15,000(e)	.....	.....
San Diego Gas & Electric—1st mtg	17,000	.....	.....
Central Power & Light—1st mtg due 1984	9,000(e)	.....	.....
Southwestern Gas & Electric—1st mtg due 1984	10,000	.....	.....
Common Stock			
Iowa-Illinois Electric & Gas	$6,000(f)	.....	.....
General Public Utilities—about 600,000 sh (to be offered on a 1-for-5 basis)	.....	.....	.....

Notes—(e) Estimated; and (f) To sell enough common stock to yield $6 million.

WORLD'S LARGEST GENERATORS are installed at EEI's new Joppa, Illinois plant. Each is rated at 216,176 kva at .85 power factor and 30 psig hydrogen pressure. Combined output will be nearly 1,000,000-kw when all 6 units are completed.

Engineers: Ebasco Services, Inc.; Contractors for Construction: Bechtel Corp.

Joppa's record 3600-rpm generators are forerunners of units with even larger ratings

Steady technical progress to bigger, higher-efficiency generators matches continuing advances in turbine design

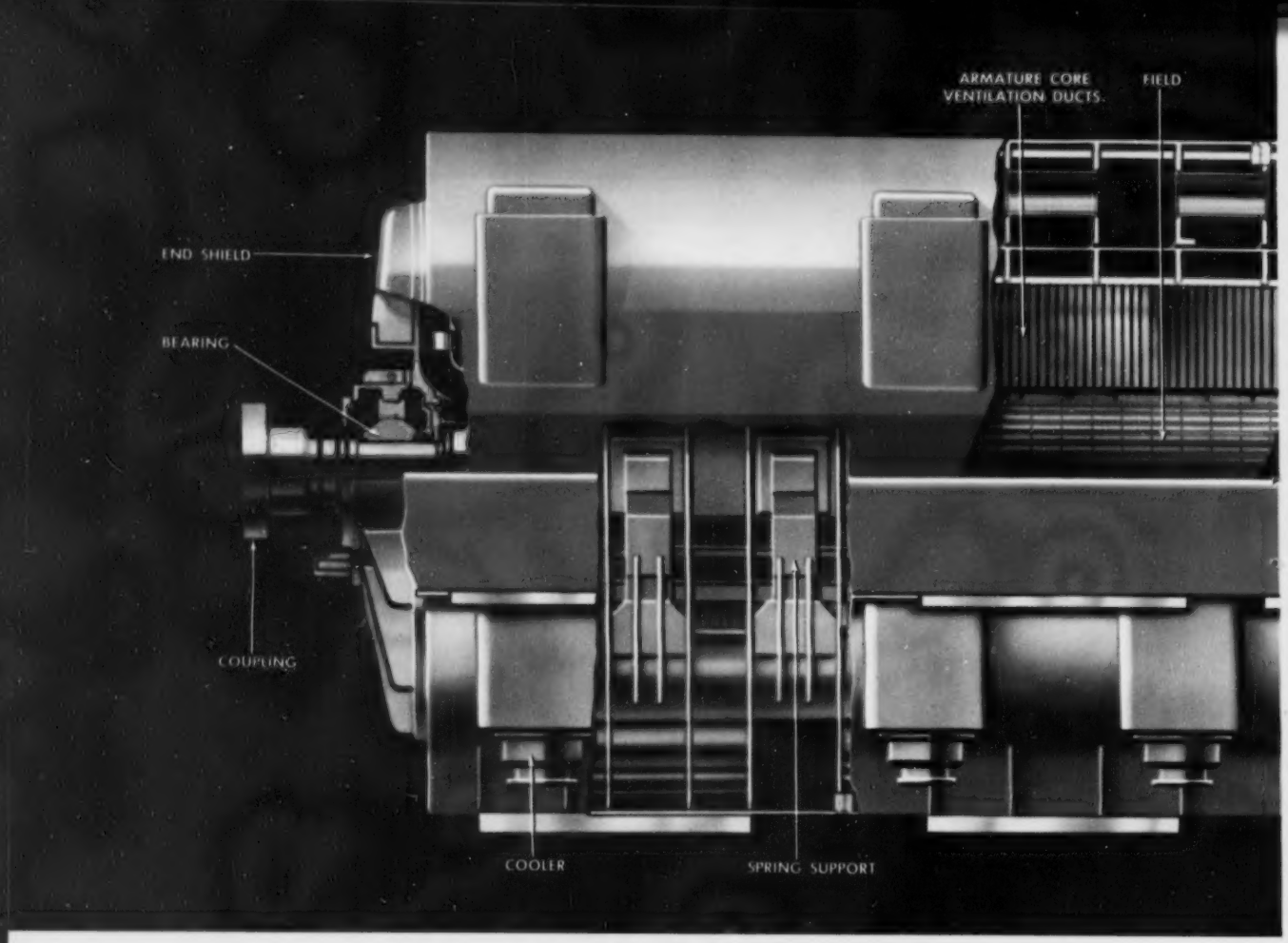
To meet the imperative need for a single generating station with an initial capacity of 625,000-kw, engineers who planned the giant new Joppa, Illinois, plant of Electric Energy, Inc. specified larger 3600-rpm turbine-generators than had ever been built before.

General Electric came up with the answer—a new 216,176-kva generator design based on service-tested engineering principles. Furthermore, because of the vital nature of the project, the new generator design was developed and the first of six units built and shipped *in only 18 months!*

Generator design progress won't stop here—demand for even larger sizes and still lower capital costs per kilowatt is growing. A total of 24 large 3600-rpm machines in the 220,000-kva size range is on order today at General Electric—and units ranging as high as 350,000 kva will be available in the near future. *General Electric Company, Schenectady 5, New York.*

GENERAL ELECTRIC

FOR DETAILS, TURN TO NEXT THREE PAGES . . .



New materials, new manufacturing techniques make possible largest 3600-rpm generators yet built

Time after time, in past years, electrical engineers have thought that the physical limitations of 3600-rpm single generator design had been reached. In every instance, new areas of progress have opened ways to extend capability of single units—from about 12,500-kva in 1929 up to better than 200,000-kva today. Here are a few of the new materials and manufacturing techniques, developed recently by General Electric generator engineers and used in the record-size Joppa generators, that will assure continuing progress in the future:

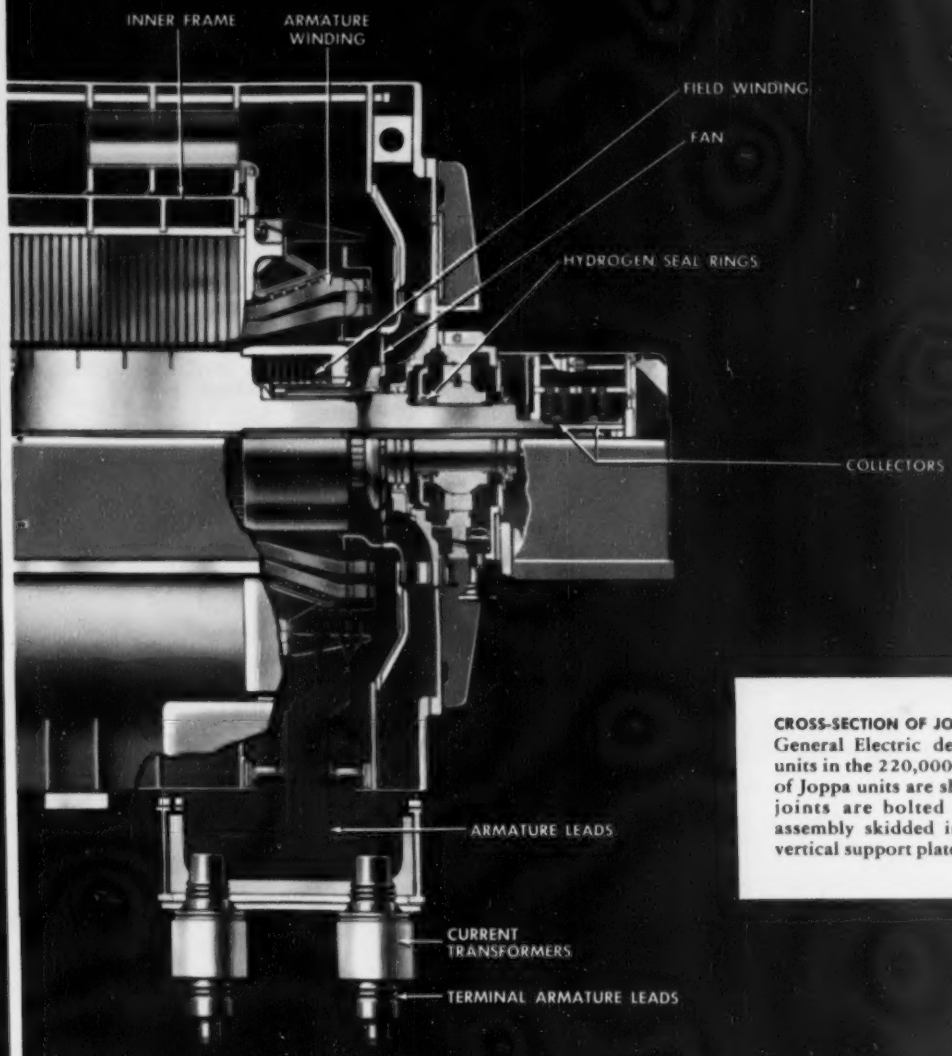
Cond-Al, a new aluminum alloy containing small percentages of silicon, magnesium and iron, has been developed by G-E research to solve the problem of high centrifugal forces that previously limited rotor size. Heat-treated and artificially aged to improve physical properties over other electrical conductor grades of aluminum, it can be used for designs in which copper would not be suitable because of stress limitations. The Joppa generators are G.E.'s first application of Cond-Al to large new machines.

Grain-oriented strip steel punchings for stators of the Joppa generators allowed units with both greater efficiency and higher ratings to be built. Tests have proven that core losses, in many cases, can be reduced by 25 to 30 percent.

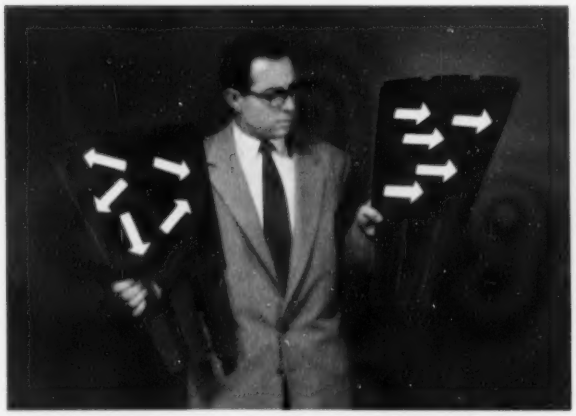
By using double-frame construction on the Joppa generators, and dividing the outer frame in three sections, diameter and weight limitations that would have prevented single-unit shipping have been overcome. This new application of an old principle provides for quick and easy assembly at the site.

These three developments are only part of the powerful new "tools" used to increase generator output. The General Electric Company is sure that generators will not be the limiting size factor in power generator equipment selection for some years to come.

GENERAL ELECTRIC

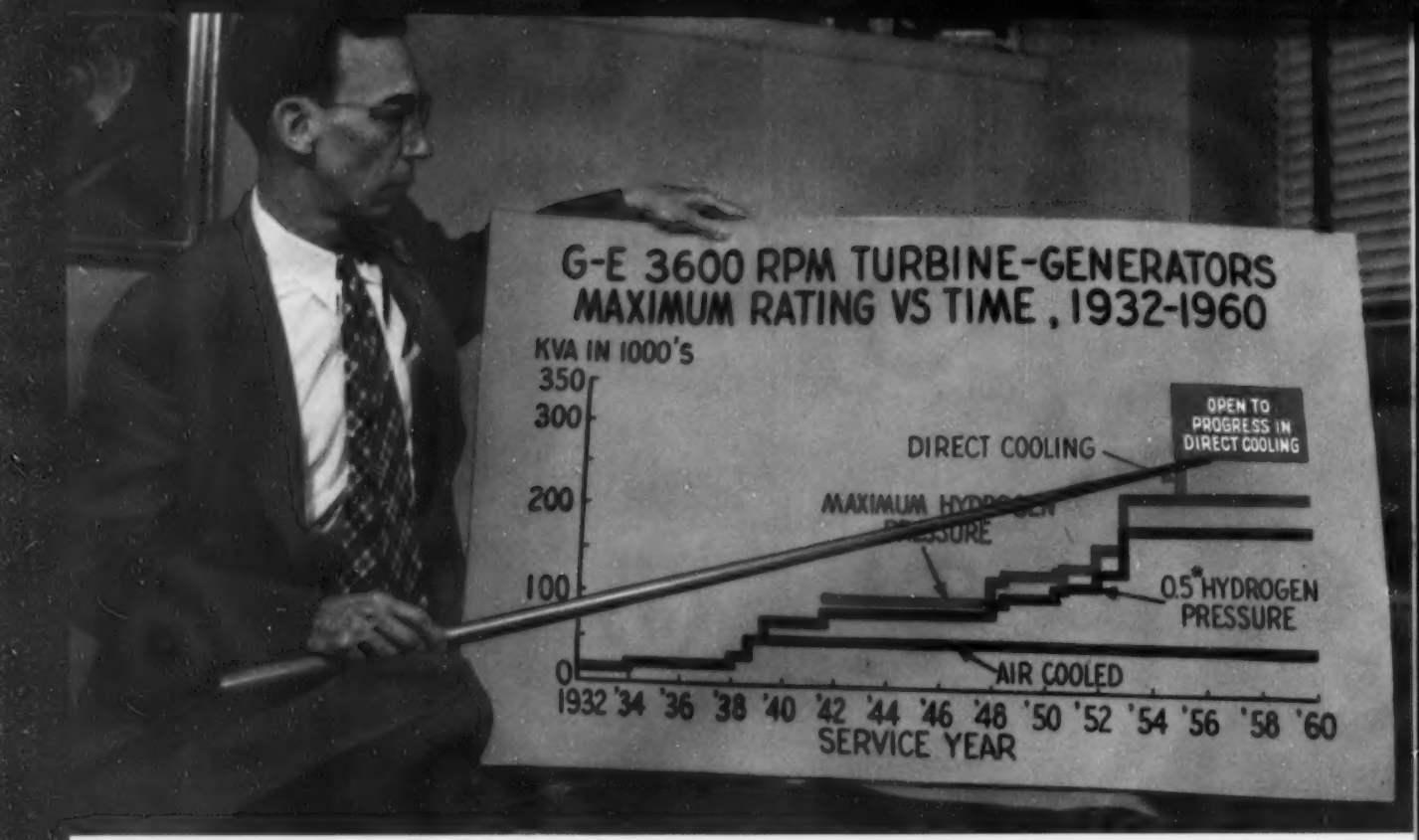


CROSS-SECTION OF JOPPA GENERATOR shows typical General Electric design for standard 3600-rpm units in the 220,000-kva size range. Outer frames of Joppa units are shipped in three sections. Girth joints are bolted and welded, cage and core assembly skidded in, and inner cage raised and vertical support plates assembled—all in a few days.



GRAIN-ORIENTED STRIP STEEL STATOR PUNCHING at right, held by generator engineer J. H. Carter, is compared with standard punching, left; arrows show difference in magnetic properties.

COND-AL WINDINGS on 54-ton Joppa field are lighter, have essentially same strength and creep characteristics as silver bearing copper, permit larger diameter for same limiting centrifugal stress.



How large can generators get?

A statement by C. E. Kilbourne, Electrical Engineer, General Electric Turbine Division

Successful development of the Joppa turbine-generators naturally raises the question of even further advances. With demands continually growing for larger and larger blocks of power, several representatives of the electric power industry are already foreseeing the need for units of 250,000 or even 300,000 kilowatts in the not-too-distant future.

How far can we go before a limit in physical size or capacity is reached? Many times in the past it has seemed that a definite answer to this question was in sight, only to have new opportunities for development opened up by improved materials and designs.

This situation still holds true today. For many reasons, however, it seems that the most probable advances in the years ahead will come through methods of raising the outputs of machines of present-day dimensions rather than through an appreciable increase in physical size. One of the most fruitful fields for progress in this direction lies in the perfection of improved methods of generator cooling. Development of hydrogen cooling has already had a pronounced effect in raising generator capacity. Much work at General Electric now centers on methods of direct gas cooling of the rotors and gas or liquid cooling of stators, which promise immense potentialities.

As a result of years of research and development, a direct-cooled rotor is already in commercial operation and a 260,000-kva generator employing both direct gas cooling of the rotor and liquid cooling of the stator is in production.

Over and above these developments are the opportunities offered by utilization of better dielectrics and advances in metallurgy. Possibilities for progress in this latter field have recently been demonstrated by such developments as grain-oriented steel and the new Cond-Al rotor winding.

How large can generators get? Probably no truly definite answer will ever be practicable. General Electric is confident that it will continue to be able to build machines that will meet all the demands of the electric utility industry in the foreseeable future. 254-8

Progress is our most important product

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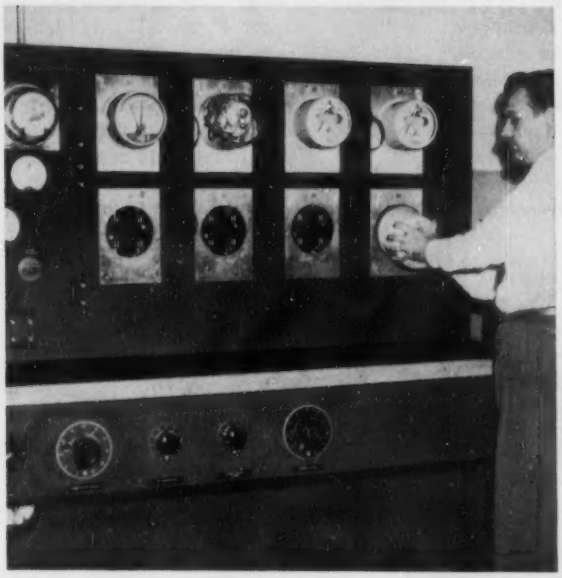
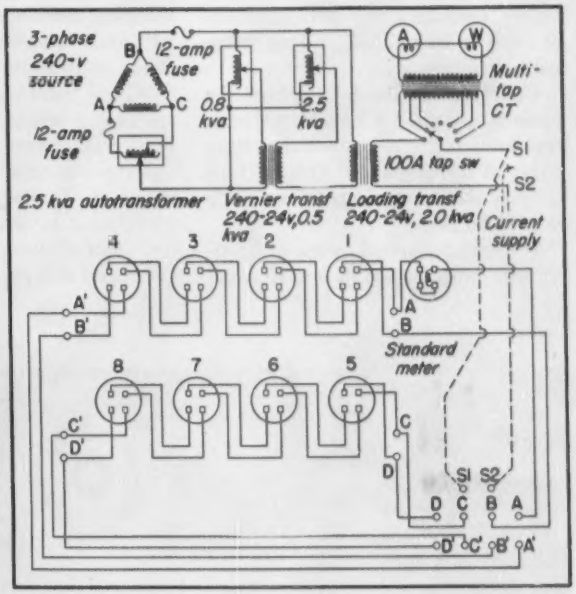


DEMAND METER TESTING is facilitated by use of this board that will test 8 meters simultaneously. Plug-in jumpers speed testing



CURRENT LOADING CIRCUIT provides currents up to 200 amp for supplying 8 meter sockets and 3-wire standard demand meter

Board Gang-Tests Demand Meters

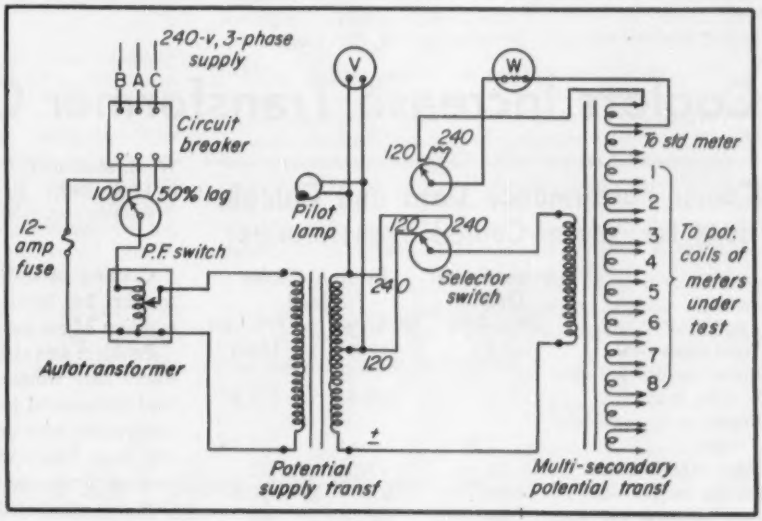
SAMUEL A. CUSHING, Essex County Electric Co, Salem, Mass.

Increasing use of mechanical and thermal types of demand meters in the Massachusetts North Shore district of the New England Electric System led to the development of a board for efficiently testing such meters. No commercial test board was available; so one was built with the aid of system meter engineers at Worcester, Boston, and Salem for use at the meter laboratory at Essex County Electric Co, in Salem. The board has the advantage of being able to gang-test 8 demand meters at one time, or test them separately or mixed, whether "A" or "S" types.

Current for testing meters is supplied from a 3-phase, 240-v source through three autotransformers and two dry-type transformers. Two autotransformers in conjunction with a dry-type transformer provide rough and vernier controls so that current output of the loading transformer is variable. The other autotransformer is for power factor control.

Connected between the loading transformer and watthour meter sockets is a multi-tap current transformer to supply an ammeter and wattmeter. This was built using the secondary winding of a through-type, 200 to 5-amp CT. Primary side has taps and a switch to provide ratios of 40, 20, 10, five, two, and one to one.

Potential for testing meters is supplied through a transformer having 16 separate secondary coils, each having a one-to-one ratio with the primary. This transformer is supplied from a



POTENTIAL SUPPLY circuit provides voltages up to 270 v. Selector switch changes primary voltage to multi-secondary transformer, which in turn supplies meters under test

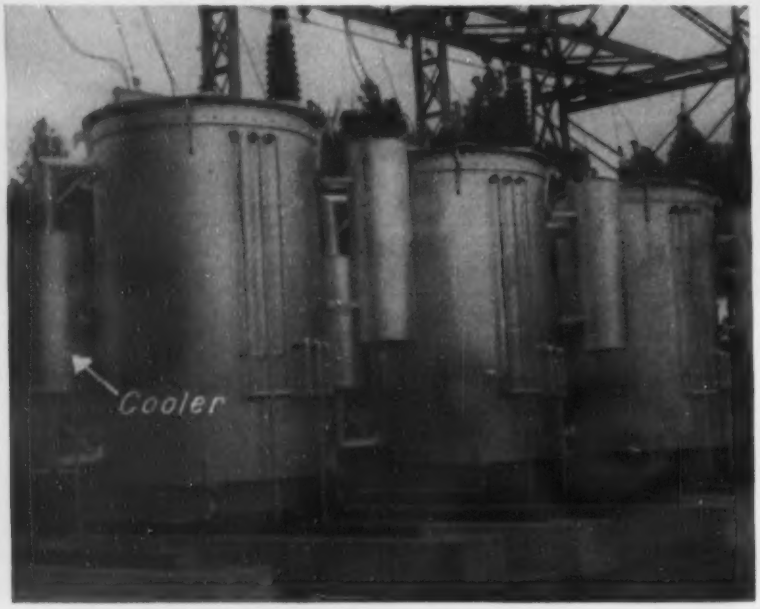
voltage control autotransformer that is connected to a 3-phase, 240-v source. A transformer with a center-tapped secondary provides either 120 or 240 v to the multi-secondary potential transformer.

Connected in the line side of the potential circuit is a switch to change one autotransformer connection from phase A to phase C. This in turn changes the power factor from unity to 50% lagging.

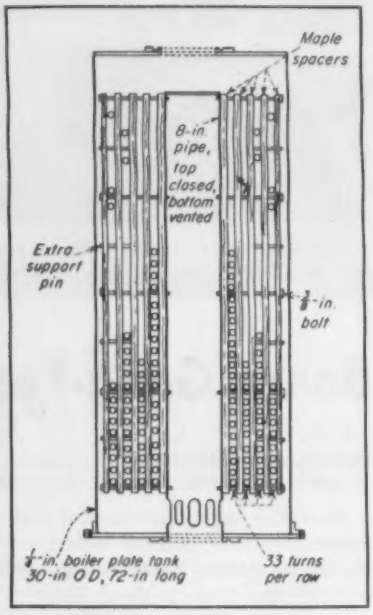
Tests are facilitated by use of jumpers with plugs, which fit into terminal receptacles on the board and provide quick and flexible means of setting up connections. A standard meter is provided for reference in making tests as well as a complete assembly of indicating instruments and controls.

Wiring, switches, and transformers are located behind the board in a compact arrangement. Circuits are designed to consume a minimum amount of energy. Components are conservatively rated to achieve many trouble-free years of testing.

General test procedure is to set up the board with 8 meters, apply potential for at least 2 hours, make necessary zero adjustments, adjust the current to the desired indication, and hold this for 45 min. If needed, further adjustments are made for corrections, a constant load is maintained for 15 min to check accuracy of adjustments, then the load is cut. Meters are allowed to return to zero position in one hour. During much of this time the company has found that the board can be left unattended except for momentary checks.



TRANSFORMER COOLERS were installed on three old units to increase capacity and reduce temperatures. Conservator tank was reinstalled for gas expansion opposite cooler


Maple spacers
8-in. pipe, top closed, bottom vented
Extra support pin
⅜-in. bolt
½-in. boiler plate tank 30-in O D, 72-in long
33 turns per row

COOLER CROSS SECTION shows the four concentric water coils made of 1-in. tubing

Coolers Increase Transformer Capacity

W. H. McCLURE, Supervisor of Substations
R. L. MURRAY, Supervisor of Equipment, Alabama Power Co, Birmingham, Ala.

Cooling of a bank of 10,000-kva water-cooled transformers has been improved and its capacity increased by addition of an external cooler on each transformer.

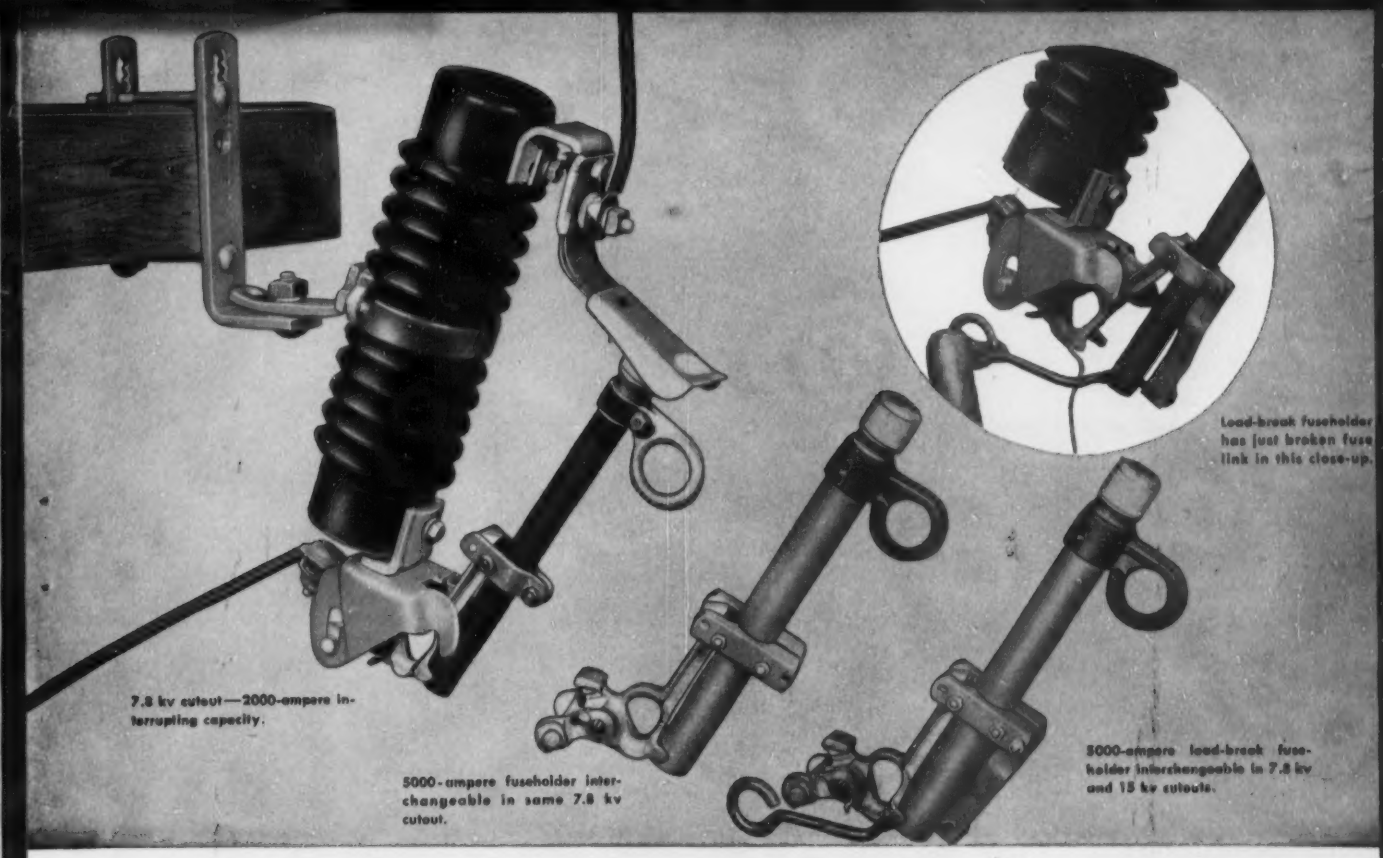
Problem was the installation of transformers in a service where they would sometimes be required to carry 125% load for several hours. Most of the factors affecting this application were unfavorable. Transformers were 27 years old, their losses were unusually high, and the maximum average temperature of cooling water was 35C.

It was calculated that the addition of an external cooler to each transformer, connected in parallel with the existing

(*Continued on page* 106)

Cooler Performance Data and Calculations for Water-Cooled Transformers

	Internal Cooler Only	External Cooler Added	
	100% Load	100% Load	125% Load
Total losses—kw	113.3	111.4	150.4
Cooler surface (oil side) —sq ft	345.1	539.8	539.8
Watts/sq in. cooler surface	2.28	1.44	1.94
Inlet water—C	35	35	35
Oil rise (n=.7)—C	34	25	30.5
Avg. cu temp.—C (LV)	78	69	79
Hot spot—C	88	....	93


7.8 kv cutout—2000-ampere interrupting capacity.
5000-ampere fuseholder interchangeable in same 7.8 kv cutout.
Load-break fuseholder has just broken fuse link in this close-up.
5000-ampere load-break fuseholder interchangeable in 7.8 kv and 15 kv cutouts.

NEW G-E OPEN DROPOUT CUTOUT

For FAULT PROTECTION—standard or heavy duty and LOAD BREAK—up to full load at any power-factor.

New simplified design of General Electric 7.8 kv and 15 kv, 100-ampere cutouts have these extra features:

Birdproof Construction accomplished by unique method of clamping the mounting support to the opposite side of insulator from live parts.

Liberal electrical and mechanical strength. New hollow tube wet process porcelain has under-cut petticoats for generous creep and strike distance; and porcelain insert fired within tube provides inside solid barrier between top and bottom live parts. Screen prevents insect nest within porcelain. Clamping U-bolt around porcelain is insulated with molded polyvinyl chloride having excellent insulating and weathering characteristics.

Compression bolting to porcelain—top and bottom fittings are bolted to insulator with porcelain under compression—for maximum mechanical strength. Compression clamps inside the porcelain maintain tight assembly.

Shielded top contact and latch—by roof-shaped contour and having ball-point contact surface to top of fuseholder, the top contact and its latch are protected from dirt deposits and sleet.

Other distinctive features are retained: Hinge guides allow slamming fuseholder from any angle; threaded cap seal at upper end of fuseholder forces expulsion gases downward; silver-plated contacts shielded from corrosive agents; vertical or angle-tilted swivel mounting with EEI-NEMA bracket; latch provides time-delay opening—assures fault current interruption before dropout action occurs; fuseholder tube of fiber and fabric-base Textolite* is water resistant, will not warp or split; close coupling of fuseholder to porcelain prevents multiplication of recoil forces.

For more information on these new open cutouts, contact your nearest G-E Sales Representative, or write to General Electric Company, Section 433-4, Schenectady 5, New York.

*Reg. trade-mark of General Electric Company

You can put your confidence in—

GENERAL ELECTRIC

GENERAL ELECTRIC

COMPLETELY NEW —

G-E Hook-on Recorder

A BRAND-NEW SOLUTION TO ONE OF YOUR CURRENT-MEASURING PROBLEMS

General Electric's new CF-7 portable hook-on recorder (volt-ammeter) gives you the first convenient means of recording current without having to cut conductors or interrupt service. Or, by simply attaching leads—you can get voltage records over a wide range.

FAST HOOK-ON INSTALLATION

Simply connect the recorder to a suitable power supply for the chart drive. Then select the proper range and hook on for up to 30 days record of current.

INSULATED TO 8.7 KV

The butyl-molded transformer carries an ASA insulation rating of 8700 volts. Other safety features include:

- Safety-lead connectors, which short circuit transformer when disconnected;
- Safety-latch on hook locks in closed position.

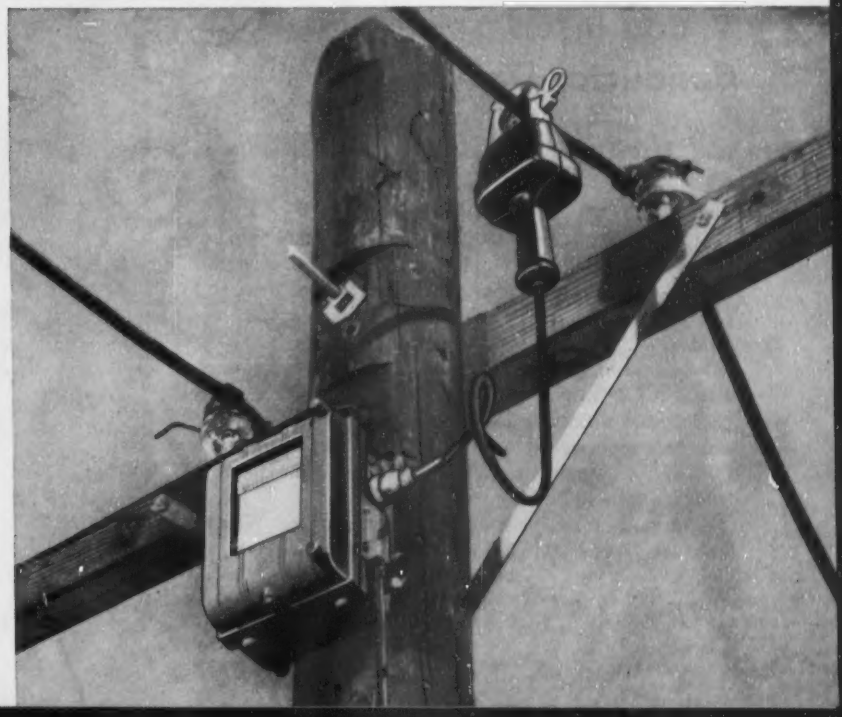
MINIMUM SERVICING

Consisting of a hook-on current transformer, connecting lead, and inkless recorder, this new instrument offers you:

- Inkless recording for minimum servicing, clean records;
- Weatherproof construction for outdoor and indoor use;
- Seven ranges—15/75/150/750 amperes, 150/300/750 volts;
- External range-selector switch;
- 120/240 volt chart drive.

For further information, contact your nearest Apparatus Sales representative or write for bulletin GEC-1225 to Section 602-267, General Electric Company, Schenectady, N. Y.

SELF-SUSPENSION of the current transformer is made possible by a spring latch. Self-locking simplifies installation in such applications as checking of line loads.



Transformer Cooler

(*Continued from page* 102)

internal cooler and to have 194.7 sq ft of oil service, would reduce the average copper temperature 9C on the same kva basis. It was further determined that the transformer could carry 125% load with essentially no increase over the original average copper temperature and with an acceptable hot-spot temperature. Accompanying table shows the data and calculations.

Heat exchangers suitable for this or similar jobs may be available from manufacturers of such equipment. However, due to lack of information and timing involved, coolers were fabricated in the company's shops. Tubes were wound without flattening from 60-ft coils of 1-in. copper tubing.

Based on analysis and experience with solving this problem we believe that it is both practical and economical to improve the cooling of water-cooled transformers whenever increased capacity or reduced operating temperatures are desired.

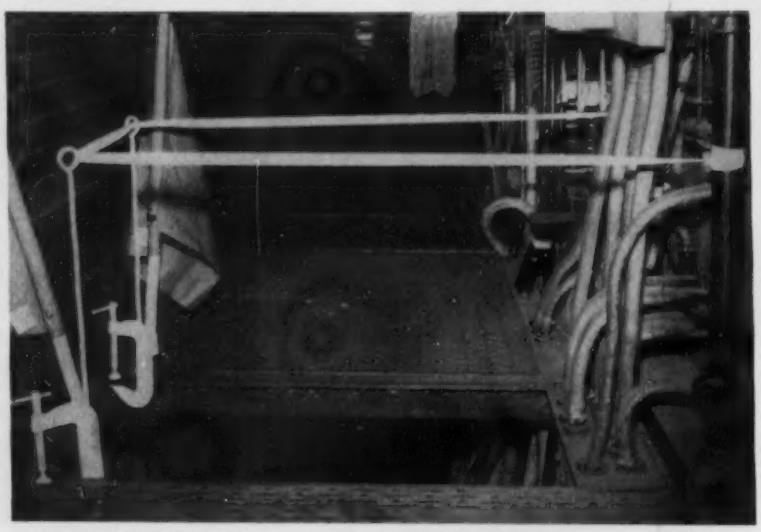
Adapted from 1953 Doble Client Conference

Clamped Barriers Rope Off Hazards

C. P. STOKES, Substation Mechanic, Indiana & Michigan Electric Co, South Bend, Ind.

Rope barrier supports clamped to floors or beams protect all persons from work openings in the floors of substations, open manholes, and other restricted areas. Used with red flags in each support, these barriers provide effective warning, require very little time to place and small storage space, and are relatively inexpensive.

Clamped supports are used because they won't topple or slide if anyone falls onto the ropes. Each rope support is a 4-in. C-clamp to which is welded a hard drawn steel rod with a rope support eye and a 1½-in. by ¾-in. pipe socket to hold a red flag. Rope with a ½ in. diam is recommended instead of white tape to provide sufficient strength.



QUICK-ATTACHABLE BARRIER uses clamps welded to eye rods for rope guard. White tape is used here to indicate clearly the position of ½-in. rope

Wood Insert Saves Conductor Damage

R. N. ALLBRITTEN, Line Sub-foreman, San Joaquin Division, Pacific Gas & Electric Co, Fresno, Calif.

Simple wood bushing reduces damage to aluminum conductor being pulled around heavy angles on steel pins. This method has been used for a year with no damage to conductors, even when pulled around angles greater than 30 deg.

Wood bushing used for installing steel pins in crossarms drilled for wood pins is cut into three equal sectors. Steel pins around which the conductor is to be pulled are raised and bushing sector is placed between pin and crossarms on side of pin where conductor will ride. Nuts then are tightened to hold bushing securely in place.

After armor rods are applied, nuts on steel pins are loosened. Wood sector is removed with screwdriver and hammer, and steel pin is secured.

out of this high-voltage laboratory comes

... THE MOST SIGNIFICANT ADVANCE IN LIGHTNING ARRESTERS SINCE THYRITE!

Revolutionary in design—developed and laboratory tested by General Electric engineers, then thoroughly field tested—the new **THYRITE* MAGNE-VALVE** station arrester establishes a *new high in over-all protective efficiency and endurance for protection of generating and substation apparatus.*

**Reg. Trademark of General Electric Co.*

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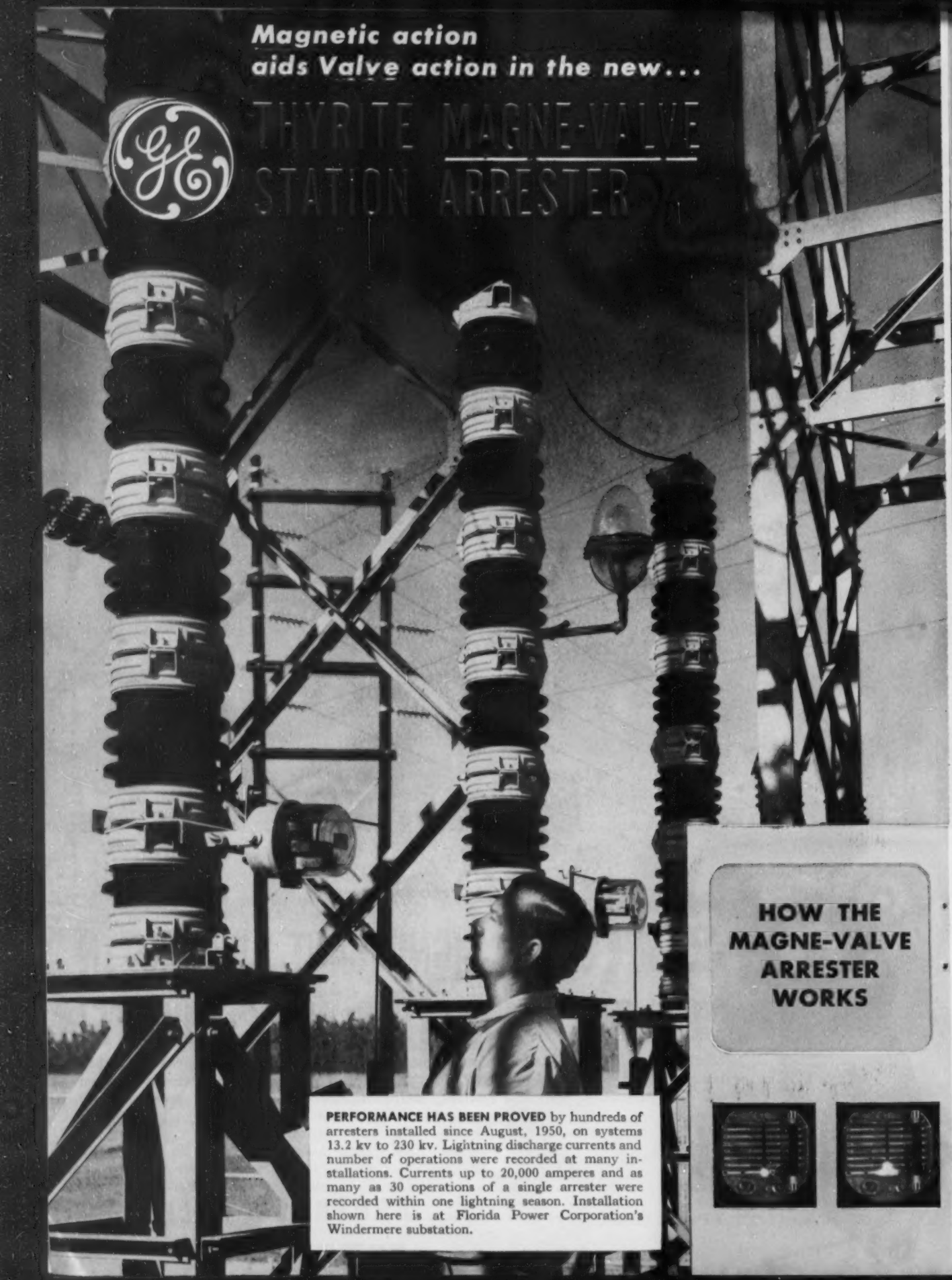
READ THE FULL STORY ON THE FOLLOWING PAGES ▶

Magnetic action
aids Valve action in the new...

THYRITE MAGNE-VALVE STATION ARRESTER



PERFORMANCE HAS BEEN PROVED by hundreds of arresters installed since August, 1950, on systems 13.2 kv to 230 kv. Lightning discharge currents and number of operations were recorded at many installations. Currents up to 20,000 amperes and as many as 30 operations of a single arrester were recorded within one lightning season. Installation shown here is at Florida Power Corporation's Windermere substation.

HOW THE MAGNE-VALVE ARRESTER WORKS

20% better protective level
3 times greater endurance

The new Thyrite* Magne-valve arrester is a major advance in reliability of co-ordinated protection of station apparatus. Let's appraise it!

FOR APPARATUS HAVING STANDARD BIL'S—

You get an unprecedented margin of protection that assures co-ordinated protection for many times higher stroke currents—even 100,000 amperes. This super-protection is especially valuable where lines or substations are not shielded or where practicable shielding may not be infallible.

You get an extra margin of protection which tends to offset adverse effects of separation between arrester and apparatus —enabling co-ordinated protection to apparatus at greater distances from the arrester.

FOR H-V APPARATUS HAVING REDUCED INSULATION—

You get as large a margin of safety in protecting 1-step reduced BIL insulation as was heretofore possible only when protecting full insulation (standard BIL). Hence, the new arrester enables a more positive approach toward reduced insulation and resulting tremendous savings in apparatus investments.

FOR DRY-TYPE TRANSFORMERS—

You get a good margin of protection—heretofore limited. Although oil- or askarel-filled transformers are distinctly preferable for connection to lines exposed to lightning, the decidedly lower impulse strength of dry-type transformers can now be better protected.

FOR APPARATUS HAVING DEPRECIATED INSULATION—

You get more positive protection—to preserve and greatly extend the operating life of old but important apparatus.

Reg. Trademark of General Electric Co.

FOR AC ROTATING MACHINES—

You get as good margin of protection to even impedance-grounded neutral rotating machines using ungrounded-neutral 100% rating arresters, as was heretofore practicable with only grounded-neutral 80% rating arrester. And for grounded-neutral machines, you can now limit the lightning stresses to 80% of the machine's 1-minute hi-pot test level. Both are important achievements for better protection of generators, synchronous condensers, and motors, alike.

FOR ALL THESE APPLICATIONS—

You get full-fledged uncompromised *station* arrester protection—6-inch diameter low-resistance Thyrite valve-disk with exclusive integrally fired ceramic insulating collar, the most efficient valve element ever offered.

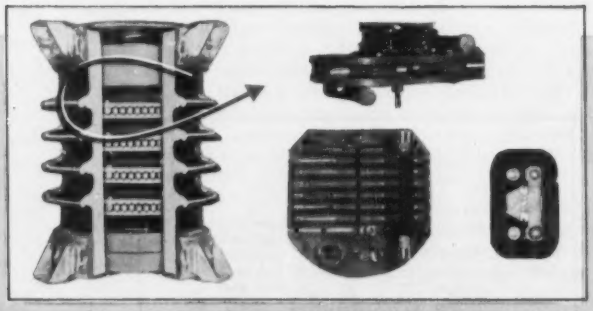
You get straight-in-line, low-resistance discharge path—28 sq. inches of cross-sectional area, with no tortuous up-and-down impedance.

You get over 3 times greater discharge capacity and thermal endurance—plenty of "guts" for withstanding high lightning currents, multiple lightning strokes, long-duration lightning discharges and severe switching surges.

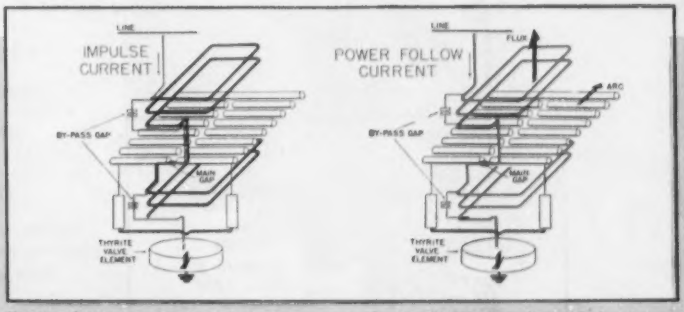
You get greater endurance now—and it protects you for future increasing discharge duty on station arresters attending trends to higher voltage lines, longer lines, greater lengths of cables, and more shunt capacitors, which increase the stored CE^2 energy in switching surges.

For more information about this new station arrester, get in touch with your nearest G-E Apparatus Sales Office or write for Bulletin GEA-1304 to Section 432-5, General Electric Company, Schenectady 5, N. Y.

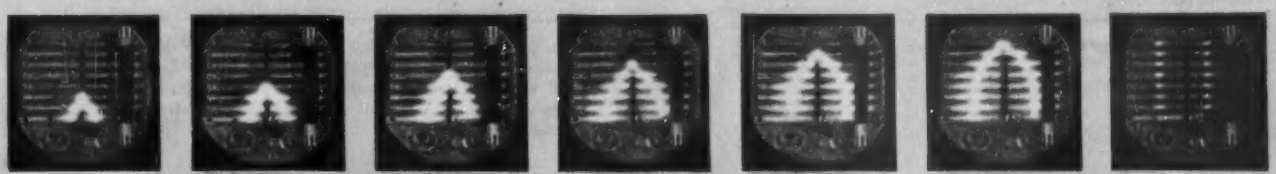
GENERAL ELECTRIC



Cut-away view of new arrester showing new gap units and their components. Gap unit (circled in red) consists of 7 pairs of adjacent gap electrodes within the field of 2 magnetic coils. One pair of electrodes constitutes main gap which controls impulse sparkover sensitivity; other pairs of electrodes form multigap path for arc-interruption of the power follow-current.



Sketch at left shows path of lightning current. Each coil has a pre-ionized shunt gap that by-passes lightning current to the discharge path shown in red. Sketch at right shows path of 60-cycle power follow-current. After lightning sparkover, the 60-cycle power follow-current flows through the coils, as shown in red, creating magnetic flux. Arrows indicate direction of magnetic flux and blowout motion of arc, which motion is the same for either polarity of the 60-cycle follow-current wave.



Film strip (from high-speed movies) shows how magnetic force sweeps power follow-current arc progressively from main gap (see extreme left) to as many as 14 multigaps in series (see second from extreme right) for efficient arc-interruption in less than a half cycle. The arc-path moves so rapidly that even hundreds of interrupting operations cause no harmful scarring or burning of gap electrodes.

Transformer Attachment to Poles
Single Transformers—100 Kva Maximum

Illustrations show transformers with EEI-NEMA support lugs. They are adapted from distribution standards which New England Electric System set up for its use, based on its own and industry sources.

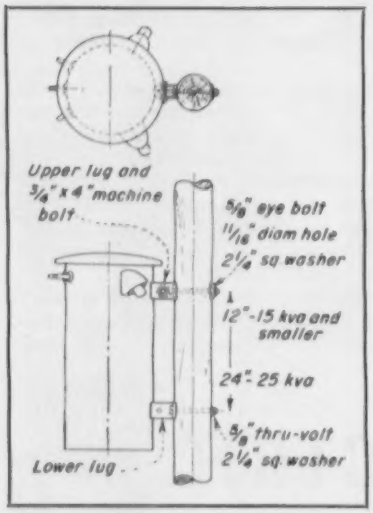


Fig. 1 Attachment for 3 to 25 kva transformers using lugs, eye- and thru-bolts

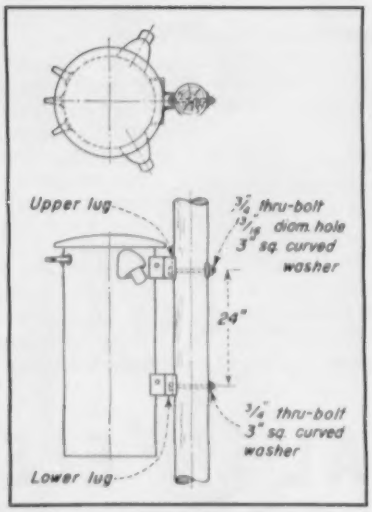


Fig. 2 Attachment for 37.5 and 50 kva transformers using lug and thru-bolts

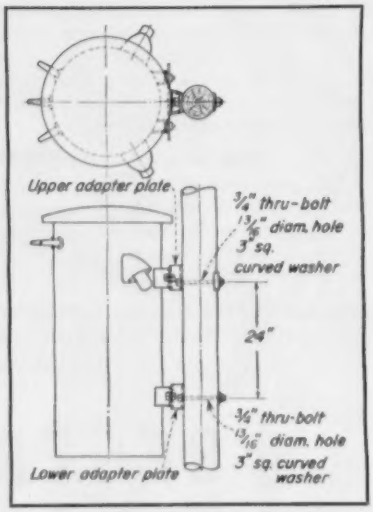


Fig. 3 Attachment for 75 and 100 kva transformers using adapter plates and thru-bolts

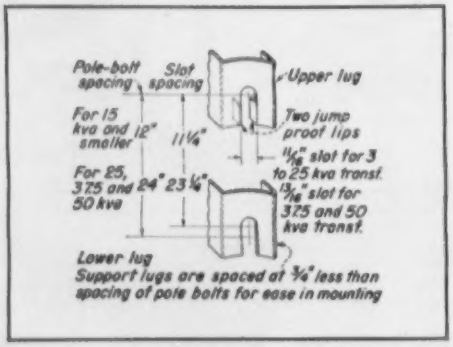

Pole-bolt spacing
Slot spacing
Upper lug
For 15 kva and 12" smaller
11 1/4"
Two jump proof lips
11/16" slot for 3 to 25 kva transf.
For 25, 37.5 and 50 kva
24"
23 1/4"
13/16" slot for 37.5 and 50 kva transf.
Lower lug
Support lugs are spaced at 3/4" less than spacing of pole bolts for ease in mounting

Fig. 4 Lugs for use with 3 to 50 kva transformers

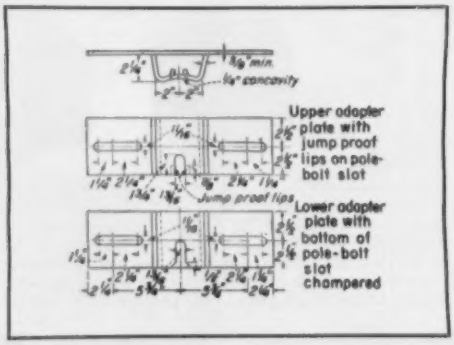

2 1/4"
5/8" min.
1/4" concavity
Upper adapter plate with jump proof lips on pole-bolt slot
Jump proof lips
Lower adapter plate with bottom of pole-bolt slot chamfered

Fig. 5 Adapter Plates. One set of Type C, EEI-NEMA plates is necessary for direct pole mounting of 75 and 100 kva transformers. Four 5/8-in. machine bolts are supplied with each set for attaching plates to transformer

DELTA-STAR builds a *Complete Line* of POWER CONNECTORS

FT
Clamp Type
Connector

Whatever your requirements there is a Delta-Star connector designed specifically to do the job. Never is there any necessity of adapting a connector to your particular application. There is available at Delta-Star the exact connector you require in clamp or solder types for copper or aluminum conductors with all the characteristics that have won such general acceptance throughout the industry.

Delta-Star clamp type connectors incorporate all three essential requirements of positive electrical and mechanical connection, ease of installation, and continuity of service over long periods of time.

TU
High Compression
Connector

Positive electrical and mechanical connection — all Delta-Star connectors are cast-to-size and surface strength is left intact by the elimination of machining. Strong gripping action is secured by the retention of a great number of minute projections which dig into the tube or cable as bolts are tightened and help prevent slippage or loosening.

Ease of installation — high compression clamp type connectors are designed as a one-piece unit with U-bolts held securely in position by bent-over yoke projections. Other types are designed whenever possible with two halves of like dimensions. Being interchangeable no care need be taken to keep them in pairs.

CS
Straight
Connector

Long continuity of service — Delta-Star connectors are cast from an alloy stronger than copper under rigid foundry control. U-bolts and nuts are of DURONZE, a non-ferrous bolt material with a splendid service record. Edges and ends are rounded to eliminate crystallization or adhesion. No detail, however small, which adds to dependability has been overlooked or neglected.

NEW CATALOG now being prepared covers the complete line of Delta-Star Power Connectors: contains Technical Data Section with Tables and Charts pertaining to application of various types. Reserve your copy.

DELTA-STAR ELECTRIC DIVISION

H. K. PORTER COMPANY, INC.
OF PITTSBURGH
2437 FULTON STREET, CHICAGO 12, ILLINOIS
DISTRICT OFFICES IN PRINCIPAL CITIES

WHEN YOU WANT THE BEST IN HIGH VOLTAGE EQUIPMENT SPECIFY DELTA-STAR

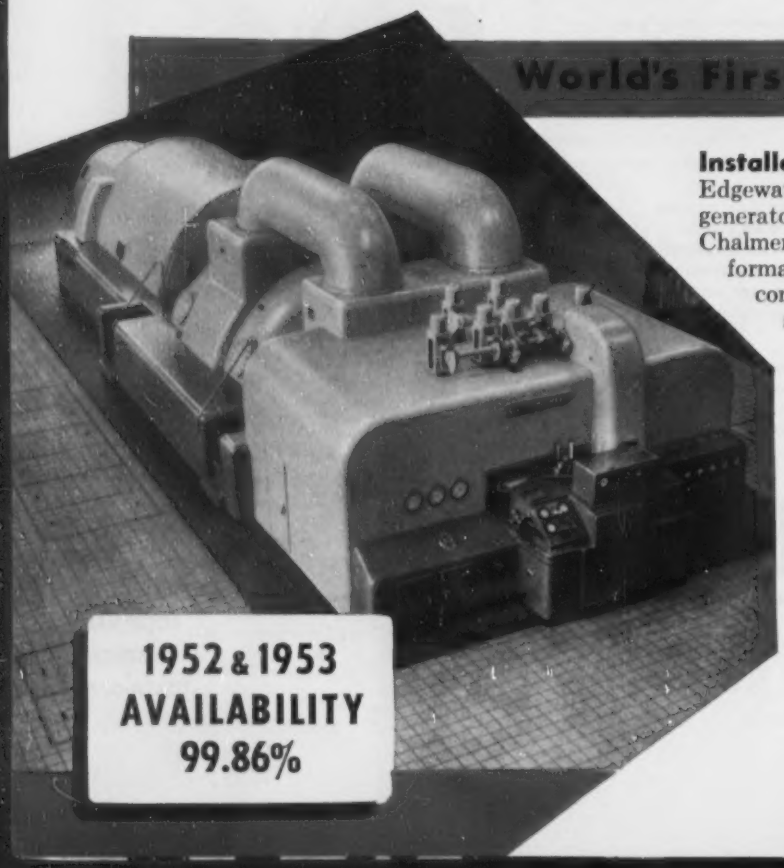
Important SUPERCHARGED

Here's what operation-proved A-C development can do for you now, and in the near future

BY CUTTING GENERATOR SIZE, *supercharged* cooling permits you to reduce plant size, lower foundation and crane costs, and use smaller breakers and bus structures. Mechanical design limitations are minimized, while possible maximum ratings are raised, and field assembly problems are simplified.

Two of the *supercharged* units now in operation are shown in the accompanying photographs. The installed units and others in various stages of production utilize direct rotor conductor cooling with high-velocity hydrogen to increase the generator rating more than 70% over conventional hydrogen cooling. Backed by experience gained from the first *supercharged* units, Allis-Chalmers is now building a *completely supercharged* generator resulting in the remarkable size reduction shown on the facing page.

For basic design information and a more detailed explanation of the many advantages of this outstanding engineering development, ask your A-C representative for the latest literature on *supercharged* cooling. Or, write to Allis-Chalmers, Milwaukee 1, Wisconsin. A-4251



World's First Supercharged Unit

Installed at Wisconsin Power and Light Company's Edgewater Station in 1951, this 60,000-kw turbine-generator unit has proved the soundness of Allis-Chalmers pioneering engineering. Its excellent performance during the first two calendar years of commercial operation *(1952 and 1953)* can be summarized as follows:

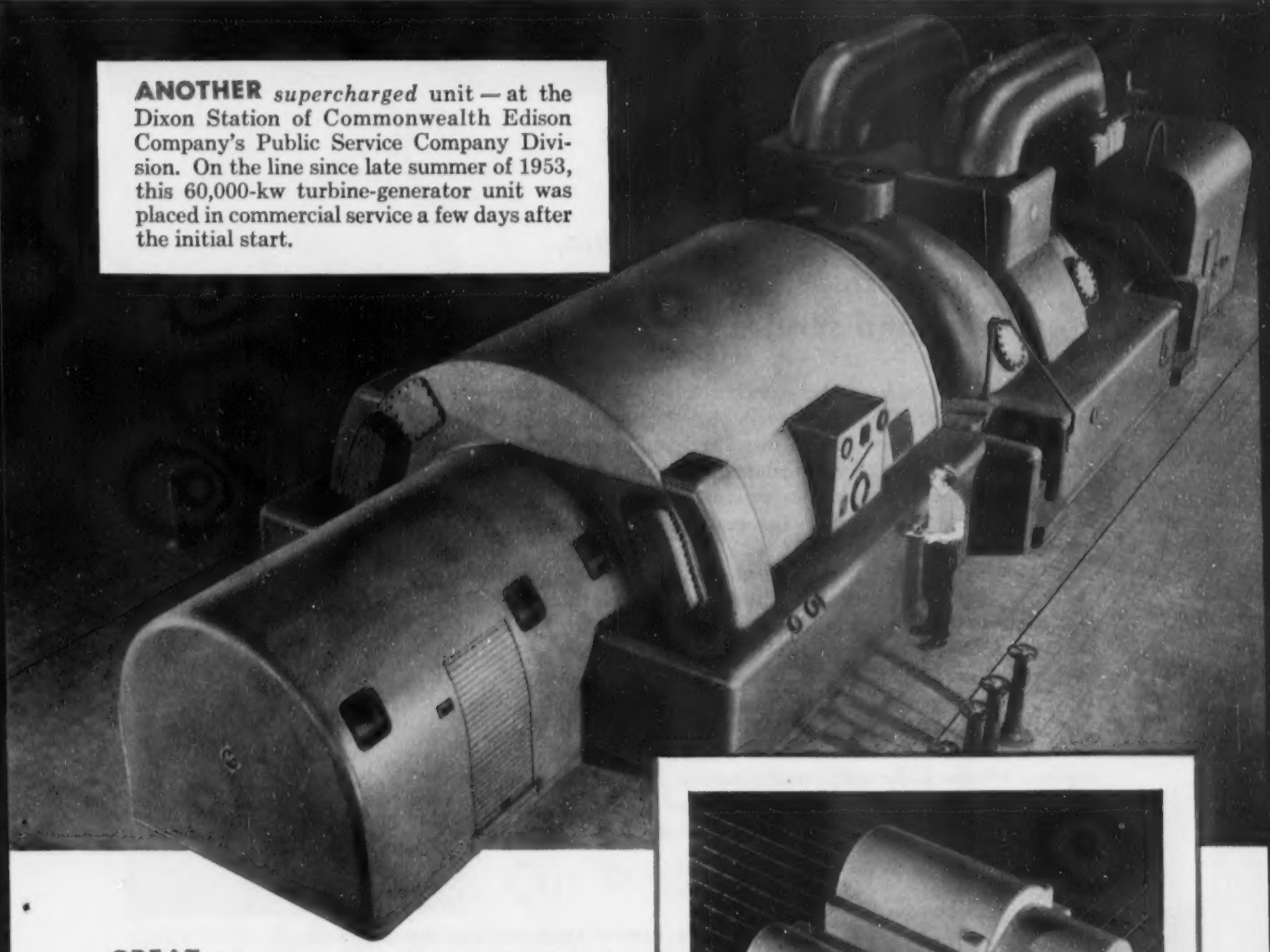
Hours in service	17,199
Service factor	98.03%
Chargeable outages	one
Availability factor	99.86%
Total generation	885,951,000 kw-hrs

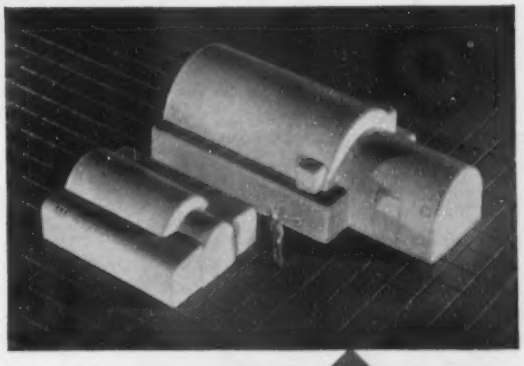
Another unit, with a *supercharged* generator but incorporating new Allis-Chalmers steam turbine design features, was placed in operation early this year at Wisconsin Power and Light Company's Rock River Station.

ALLIS-

Facts About Cooling

ANOTHER *supercharged* unit — at the Dixon Station of Commonwealth Edison Company's Public Service Company Division. On the line since late summer of 1953, this 60,000-kw turbine-generator unit was placed in commercial service a few days after the initial start.





GREAT difference in size of *fully supercharged* and standard hydrogen-cooled generators of same kw rating suggests the increased advantages full supercharging offers in power plant space, crane capacity, quantity of gas, cooling water requirements, differential expansion, shipping clearances, and many other first-cost and operating factors.

CHALMERS

A-C ALLIS-CHALMERS

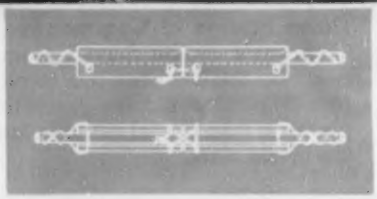
LINEMAN—SPARE THAT TREE!

PINCO TREE INSULATORS provide maximum, permanent protection for tree, wire and service

Up until Pinco Tree Insulators were introduced, beautiful trees such as these majestic Eucalyptus were becoming daily casualties to ever-expanding power lines. Today, thanks to Pinco foresight and pioneering, Pinco Tree Insulators provide the answer to an old and troublesome problem—permitting utilities to string lines *safely* without marring the beauty of cherished landmarks.

The super-hard, super-smooth surfaces of Pinco Tree Insulators resist the abrasive action of trees, branches or other obstructions. And their mechanical strength is such that, on test, they withstand repeated side hammer-blows up to 100 inch pounds without failure! The porcelain itself . . . produced by the Pinco Wet Plastic Process, guarantees high dielectric quality.

In service, Pinco Tree Insulators have conclusively proved their superior efficiency, durability and economy. Many users state that they *save their original cost every year!* May we submit facts, figures and samples to prove this point to *you?*



THE PINCO TREE INSULATOR
is attached directly to the wire it protects . . . unaffected by the sway of limbs, remaining permanently in place. It may be used singly or in multiple; the diagram above shows the method of attaching two or more to the conductor.

THE PINCO TREE INSULATOR NO. 3600
for power and light primary and secondary, power and light services, etc. (cable up to 1" diameter) . . . is made in 12", 14" and 16" lengths. Other models are available for heavier or lighter service.
U.S. Patent No. 2,361,109

PINCO INSULATORS
RIGHT ON THE JOB

The Porcelain Insulator Corporation
LIMA, NEW YORK

Ladder Attachments Hold and Hoist Armor Rods

Ladder attachments facilitate hoisting a complete set of armor rods up a tower, when the ladder is hoisted. The attachments, which hold rods, consist of a container fastened at the bottom of a ladder and a retaining ring fastened further up the side.

This hoisting method replaces a more time-delaying and cumbersome one in which linemen ascend the towers, get into position on ladders, and have rods hoisted to them on a hand line.

Preformed Line Products Co

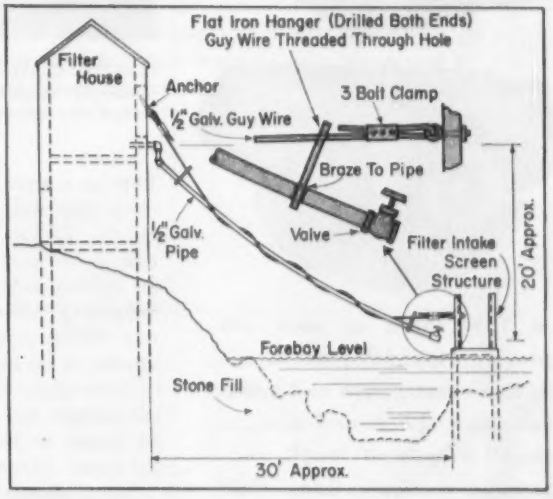
Suspension Rig Solves Piping Problem

P. B. BLIZZARD, Mechanical Engineer, Kanawha Valley Power Co, Charlestown, W. Va.

Suspending a ½-in. pipe between a filter house and screen structure was the solution for a permanent water pipe connection to clean clogged water screens. Previously it was necessary to run a hose from the filter house more than 30 ft over rugged sloping land and the forebay to the screens.

For the pipe suspension, eye bolts were attached above pipe ends at the filter house and intake structure. Between them a ½-in. galvanized guy wire was spiraled around the pipe, held in the desired position by pieces welded near the pipe ends, and by 3-bolt clamps as shown in the illustration.

Valves at both ends of the pipe make it possible to drain the pipe in freezing weather. In winter flushing water is made available at the screens by opening the valve at the filter house. In summer only the valve at the discharge end need be operated.



PIPE SUSPENSION facilitates cleaning clogged water screens at intake

Glass Insulators Cut Replacements 50%

A. G. LOUDON, General Manager, Clay Electric Cooperative, Inc, Keystone Heights, Fla.

The use of tempered glass pin-type insulators by Clay Electric Cooperative, Inc, reduced maintenance costs 70% through fewer service calls and fewer insulator replacements. As a result of their performance record over the past 5 years on the company's 3,500 miles of lines covering a 5,500 sq mi area in the north and central sections of Florida, Clay Electric is installing them on all new lines. They are also being used exclusively to replace all insulators that fail.

To date, replacements of glass insulators have run 50% less than any other type tried. Thus far, there has been no evidence of damage by lightning, although more than 10,000 of these insulators have been in use by the company, which is located in the area having the highest number of lightning storm days a year in the United States.

The Clay Cooperative serves 11,000 rural and urban consumers over a 13-county, sparsely settled area. It has a constant problem of heavy moisture content in the air, because its lines traverse thickly wooded areas and skirt or cross dozens of fresh water lakes.

The first 144 experimental tempered glass insulators, installed in

The Old Reliable

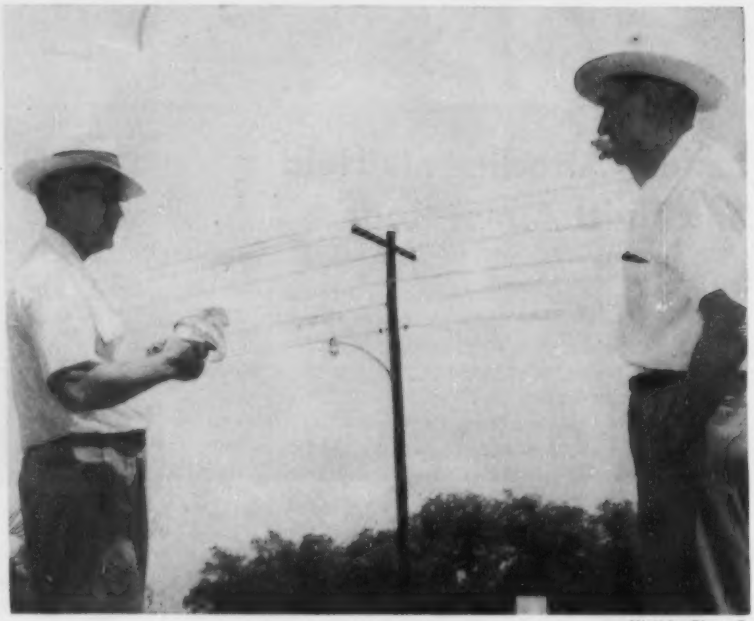
EVERSTICK ANCHORS...

EXTRA Holding Power
QUICKLY Installed
TOUGH For long life

● They speed up work and provide dependable anchorage in new construction and maintenance. Quick and easy to install—made of tough rust-resistant malleable iron—their holding power "tops" all others. Available two-way, three-way, four-way, and cone types. Write for facts.

Exclusive Everstick nut housing. Locks anchor firmly on rod. No chance of rod slipping thru anchor.

EVERSTICK ANCHOR CO.
Manufacturers of "THE ANCHOR OF MERIT"
FAIRFIELD, IOWA



Kimble Glass Co

TEMPERED GLASS INSULATORS require fewer service calls and fewer insulator replacements —reducing maintenance costs 70%. Insulators withstand impact, shocks, temperature changes and lightning in area of country having highest number of lightning storms

1948 on a seven-mile, 7,200-v, single-phase line were trouble-free for 10 months. In 5 yr there have been only four failures, mostly as a result of the marksmanship of riflemen. In one instance a failure occurred when a tree fell on a pole, breaking an insulator. A maintenance man was able to drive along 30 mi of line, locate the damage, and replace the insulator, all within an hour of the report of the power failure.

Storm damage which has run as high as $25,000 a year on Clay lines is not the only troublesome weather problem. Ordinary annealed glass insulators formerly used on the lines frequently cracked or failed when subjected to extreme high temperatures and then sudden cold rain. However, there has not been a single instance of a tempered glass insulator failing under such conditions.

When a force sufficient to cause a failure occurs it causes the tempered glass insulator to distintegrate into small, non-sharp, popcorn size fragments. Linemen can locate such a failure at a glance from the ground. He can drive along a line at 70 mph and still determine very easily where the faulty tempered glass insulator is missing. With other types it sometimes takes hours of tedious pole-climbing to find the cracked insulator which disrupts power distribution.

One of our chief problems, particularly in the rural area, is the marksmen who like to test their accuracy with rifle or slingshot on power line insulators. Our experience has shown that the tempered glass insulator will withstand thrown stones and even glancing hits from a .22 caliber bullet, a real economy in the territory we cover.

In contrast to other type materials, tempered glass, characteristically, is not subject to cracks, fissures, pin holes, or other defects which work toward progressive deterioration. This principal cause for intermittent interruptions of service is one of the most costly and troublesome problems in the distribution of power, particularly in rural areas.

One of the common maintenance problems that tempered glass insulators overcome is the leakage of power through perforated or cracked insulators which short out to the pin and cause radio and television interference. This has never been experienced on the lines equipped with the new insulators.

Where the tempered glass insulator has distintegrated under impact of some force, the line has never burned in two. When the insulator is gone the tie wire which loops over the pin causes a fault.

(*Continued on page* 129)

H. B. Thacker, Westinghouse Electric Utility Engineering Department, presents a group of Westinghouse engineers with their approaches to your problem of . . .

Providing maximum reliability for rural service

Harry Thacker specializes in solving distribution problems. His wide experience in all phases of power distribution stems from personal contact with utilities throughout the nation. On the following pages, he will lead a panel of Westinghouse experts discussing specific and practical ways to gain maximum reliability on rural power systems.

Let's start right at the substation . . .
Tex Brannan of the Transformer Division quotes a pioneer in the application of single-feeder unit subs for outlying areas.

Recent Substation Installation being discussed by Mr. Van Antwerp (left) and Mr. Knouse (right), both of Philadelphia Electric, and Mr. Brannan. Mr. Knouse is pointing out the clean simplicity of the station.

Contoured Design — latest advance in neatness and safety of single-feeder unit substations.

17-year record proves single-feeder unit substations meet new conditions with "better job . . . lower cost"

In 1944, Mr. G. S. Van Antwerp of the Philadelphia Electric Company, writing for publication, offered this conclusion: "The more generous use of the high tension system to reach closer to the customer, with the small-type unit substation as step-down, gives promise of meeting new conditions with a better job at lower cost."* Now, 17 years after their first substation was installed, there is ample evidence that the "promise" has been fulfilled.

While the basic fact . . . that unit substations make it easier to carry high voltage close to the load . . . remains unchanged, many of the advantages provided by Westinghouse unit substations have been vastly improved:

"Installations can be made attractive." Now a Westinghouse integral unit substation ("CSP"® Power Transformer) can be installed without overhead structures . . . even without protective fencing when leads are underground. New "contoured-design" units are outstanding for their neatness.

"Leases (of sites) can be short . . . negotiated more readily." Now it is a relatively simple matter to pick up the entire unit and move it, if necessary, because of land problems, or because of load shifts. Adjacent property owners are generally pleased with the attractive stations; consider them good neighbors.

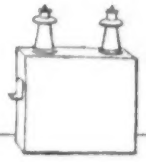
"Everything is at hand, enclosed and well-protected." Primarily, this means safety; with all live parts locked behind dead-front doors. Second, convenience; field inspection and maintenance are simplified by the ready accessibility of all parts, instruments and auxiliaries. Third, protection; the entire unit is weatherproof.

"Kept well painted — it's such an easy job." And easier than ever today with fewer offsets, plus full-length doors, to make repainting quick and simple. More than that, "Coastal Finish" and improved methods of application will eliminate the repainting problem for years.

Many electric utilities and services are modernizing distribution circuits with Westinghouse "CSP" power transformers in high-density as well as in rural locations. They alleviate such problems as flexibility, safety, real estate restrictions and regulation.

*The quotations are from an article in which Mr. Van Antwerp spoke of "unit-type transformers" generically. Westinghouse was the pioneer supplier cooperating in their development . . . leads today in outstanding advancements.

Additional ways of improving regulation are explored on the following pages.



YOU CAN BE SURE...IF IT'S Westinghouse

Here's "Rusty" Campbell* to tell you about an outstanding development affecting reliability of switched capacitors.

This all-weather switched capacitor meets every service condition

Bitter cold or blistering heat — it's all the same to this Westinghouse Autotrol†. In this installation, Wisconsin Power and Light Co. gets all the benefits of automatically switched capacitors and *none* of the headaches caused by temperature extremes.

The reason: an all-weather capacitor unit developed by Westinghouse. Through coordinated design features and improvements in the Inerteen® impregnant, the working range of the new capacitor extends down to -40°F and above the industry standard of 115°F (average ambient). Its reliability and operating efficiency at these extreme temperatures have been thoroughly proved in over 3 years of field experience.

This outstanding capacitor advance entirely eliminates special capacitors for high- and low-temperature applications. Just *one* standard Westinghouse capacitor will meet every service condition on your system.

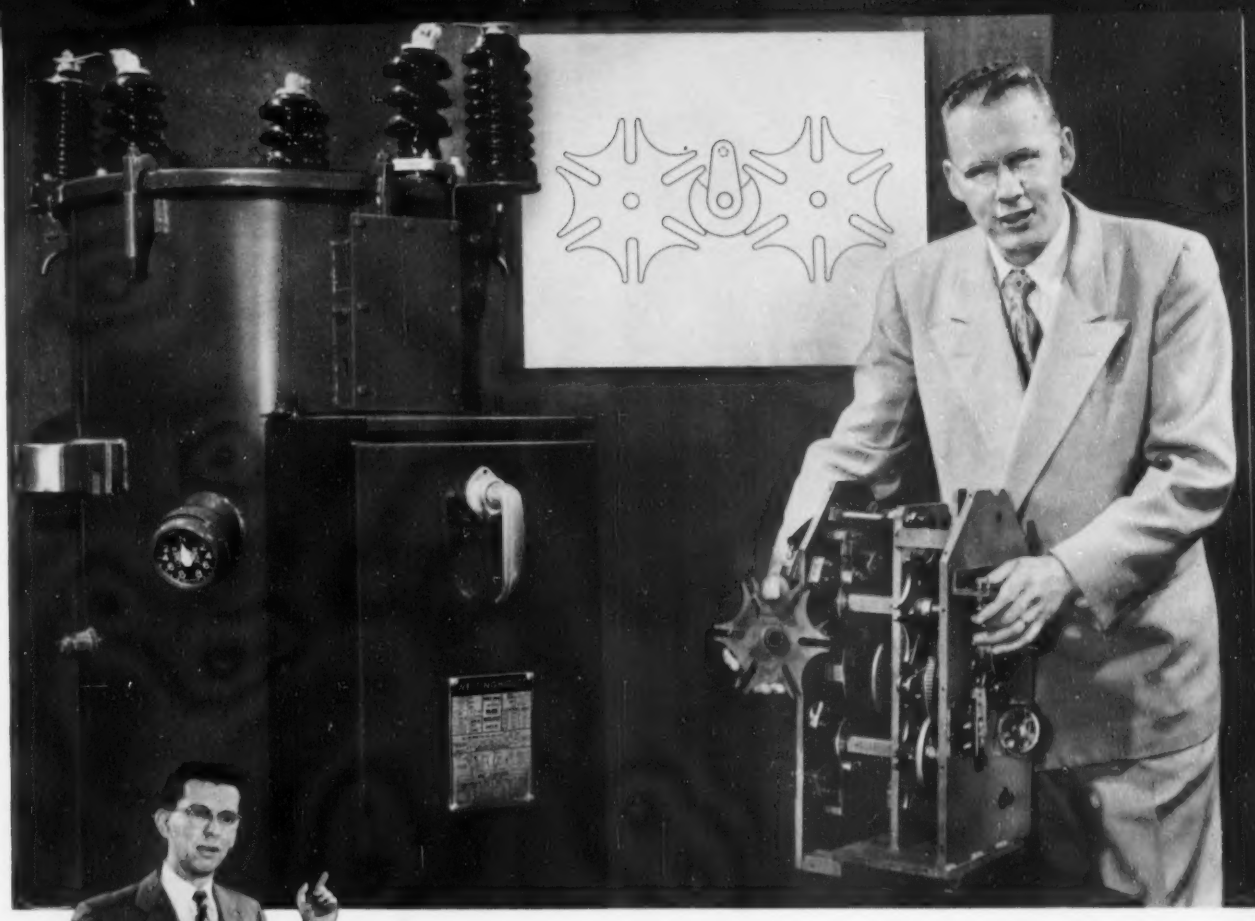
Furthermore, the Westinghouse Autotrol is the most weather-resistant capacitor bank you can buy. Racks and switches are hot-dip galvanized. Units are sprayed with molten metallic zinc. Capacitor bushings are solder sealed. You can install Autotrols and forget them — no exterior maintenance is needed.

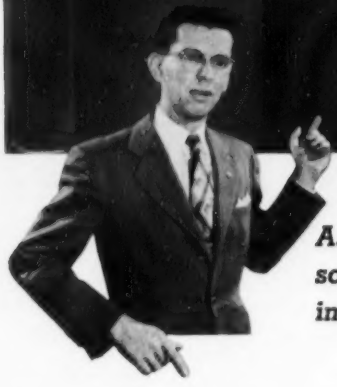
If reactive loads in spread-out areas have been cutting down your line capacity, remember this: Westinghouse Autotrols can solve your problem at a cost of only $5.66 per kvar — far cheaper than new lines and transformers.

**Product Engineer.*
†Trade-Mark

YOU CAN BE **SURE**...IF IT'S

Westinghouse





A. L. Cleveland, Regulator Application Engineer, says continuity of voltage level is an important part of service continuity.

Simplicity and accuracy of the URL-16 regulator increase the reliability of rural line voltage control

Westinghouse developed the URL-16 for pole and station applications, to help you solve two of your critical problems:

- **Accurate, dependable regulation**
- **Minimum maintenance**

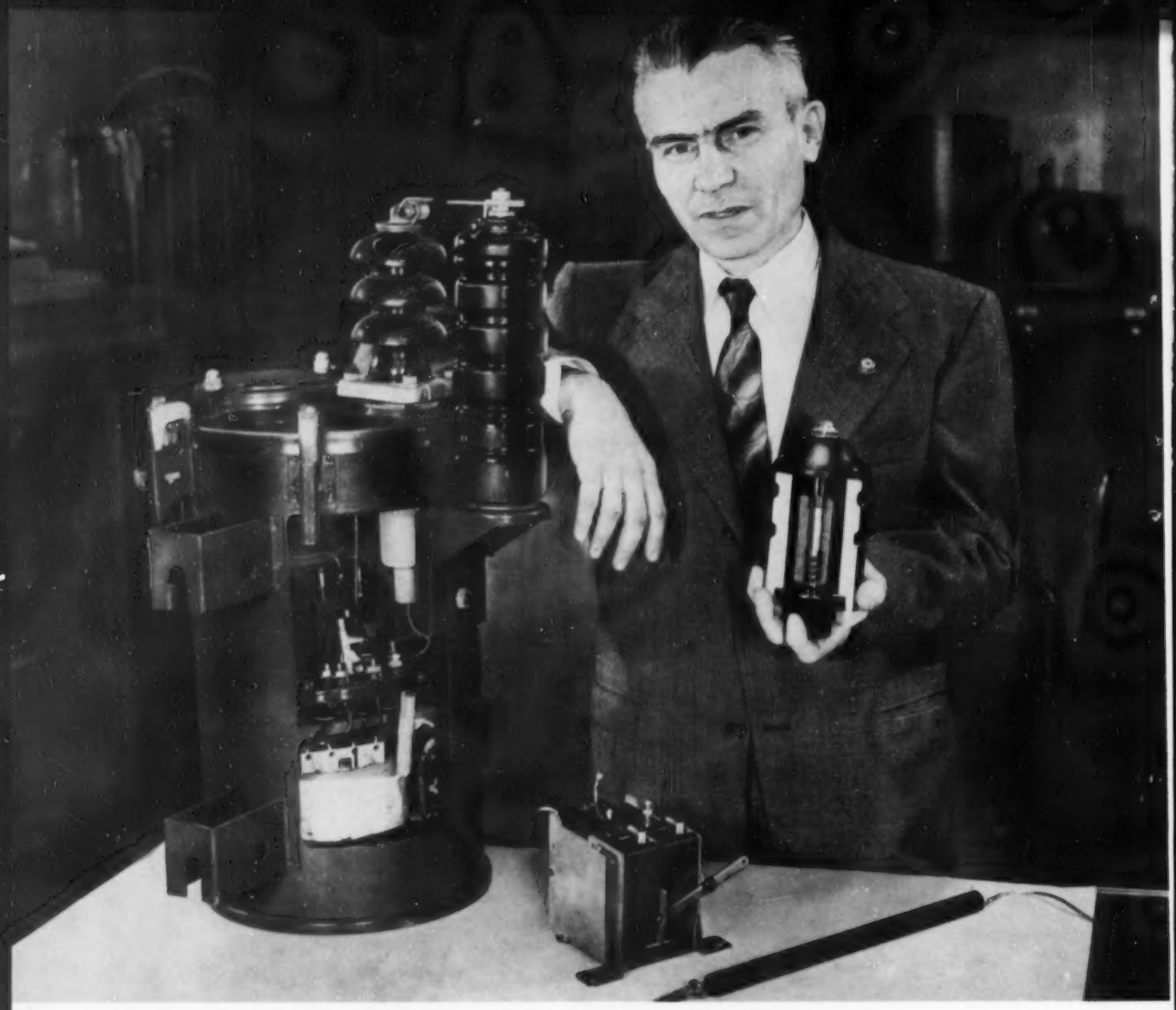
These factors have become increasingly important to service reliability, particularly in view of the increased loads imposed on rural lines today.

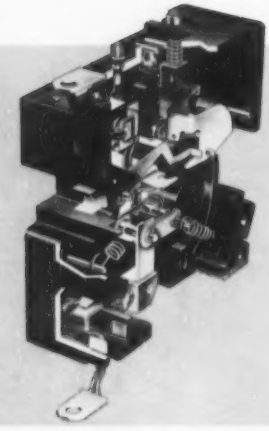
The directly driven tap changer eliminates springs, latches and shock-absorbing devices. Its Geneva gear action has smooth acceleration and deceleration, providing shockless operation with high speed during the arcing cycle. Long contact life is the natural result.

Sixteen steps cover the full range of regulation required on distribution lines. Sixteen steps also provide smooth transitions; avoid unnecessary operations and resulting wear.

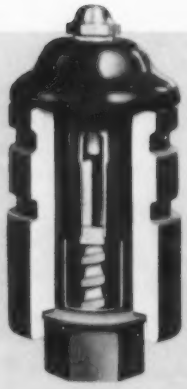
The "induction-disc," voltage-regulating relay provides the correct speed of response to each individual voltage fluctuation. This relay, found only on Westinghouse URL-16's, assures accuracy with an absolute minimum number of operations.

For some startling figures on the reduction of outages "CSP" transformers can make, read the next two pages.





Breaker cutaway — Westinghouse "CSP" breakers are actuated by copper temperature . . . not merely oil temperature or magnitude of current.



LX-T cutaway – LX-T arrester with spiral filler has three times the power-follow current interrupting capacity of previous expulsion arresters.

Protective Links — Mounted inside the transformer, under oil, protective links have consistent characteristics.

Merrill Leonard, Section Manager of Distribution Transformer Development, makes a strong statement about rural service continuity, and backs it up with facts . . .

Factory coordination of "CSP®" devices cuts transformer outages as much as 6 to 1

That's right . . . 6 to 1; specifically, experience has proved that line crews make six times as many trips to replace fuses in conventional transformers as they do to reset "CSP" breakers.

There are good sound reasons behind that fact. They may be summarized in a single word, "coordination."

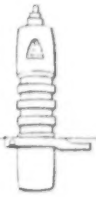
First, thermal coordination. The Westinghouse "CSP" breaker is actuated by the temperature of the copper in the transformer coil . . . not merely oil temperature or magnitude of current. This means that, unlike the fuse, the breaker "watches" the heating in the coil to protect it against the possibility of burnout, since the trip point is coordinated with the transformer thermal capability. The protective link, of course, is set to coordinate with the breaker so that its fusing point will always be above the level of the breaker operation, thus it cannot operate because of any fault on the low-voltage side.

Second, surge coordination. This is obtained first by the design of the lightning arrester to coordinate with the bushing insulation level, and the bushing, in turn, to coordinate with the insulation strength of the coils. This coordination is improved by the fact that the arrester is mounted directly on the equipment which it protects. In addition, the new LX-T arrester, through its greater power-follow current handling ability, is applicable to systems of greater power concentration.

Third, system coordination. This is made easier because the operating levels of the protective link and the breaker are set as close together as possible.

On rural lines where every trouble-shooting trip is a long, time-consuming haul, features like these are worth their weight in gold.

Now, for improved protection of conventional transformers, turn the page.



YOU CAN BE **SURE**...IF IT'S

Westinghouse

There's a new look in lightning protection. Here's Bob Innis, Distribution Apparatus Design Engineer, to tell you all about it.

More reliable lightning protection—the new LX

Note the new look of this new Westinghouse LX lightning arrester. Improved interrupter offers greater current-limiting action which gives the LX arrester the highest short-circuit rating of any expulsion arrester — 20,000 amperes at 3 kv. This rating is 100% higher than any other expulsion arrester. It means you can apply LX arresters today, with assurance that they will handle tomorrow's higher power-follow currents resulting from system growth.

Industry standards state that the short-circuit rating must be placed on the nameplate of the arrester. Westinghouse has complied with this on the new LX as follows:

3 kv — 20,000 amperes
6 kv — 16,000 amperes
9 kv — 12,000 amperes
12 kv — 6,000 amperes
15 kv — 3,000 amperes
18 kv — 1,500 amperes

The unique arc spiraling action of the LX prevents establishment of power-follow current on the majority of arrester discharges. When power current does follow, it is chopped off in a fraction of a half cycle.

Win the war against lightning on your system. Install the extra-reliable Westinghouse LX arrester.

Needed for rural service:
a reliable open cutout.
Fred Reiber* has the answer.

New . . .
a simple and rugged open fuse cutout

You've never seen a sturdier, simpler cutout than this. It's the new Westinghouse DX open fuse cutout—and it offers you a degree of reliability you never had before on your distribution circuits.

The DX is reliable because it's *simple.* There's no complicated mechanism — nothing to go wrong in closing, opening, or re-fusing. When a fuse blows, the simple toggle mechanism provides fast, positive dropout. The fuse holder is easy to remove because the entire front of the cutout is open — easy to replace because top and bottom contacts align perfectly, regardless of the angle of closing.

The DX is reliable because it's *rugged.* Metal parts are clamped — not cemented — to porcelain, eliminating recesses and providing extra strength. The large-area, silver-plated contacts maintain good contact pressure. And you can say good-by to sleet troubles — large metal shields, top and bottom, completely protect the contacts.

Built to take the worst that weather and linemen can give, year after year, the Westinghouse DX is the cutout you need to boost system reliability and cut operating and maintenance costs. They are available in 5.2, 7.8 and 15-kv; interrupting capacity 2000 to 5000 amperes.

**Manager, Switchgear Distribution Apparatus Sales.*

On the following pages you'll find interesting facts about automatic protection of feeder circuits.

YOU CAN BE **SURE**...IF IT'S

Westinghouse

Automatic protective devices must function dependably in system emergencies. Bob Lawrence, Product Engineer, tells how . . .

Safe operation and easy maintenance of reclosers and sectionalizers enhance system reliability

The rapidly expanding use of reclosers and sectionalizers is a vital factor in achieving greater reliability of service in rural areas. And of all such devices available today, Westinghouse reclosers and sectionalizers are the most dependable — for two reasons: (1) The simpler operating mechanism makes them *inherently reliable.* (2) The extraordinary safety, ease and economy with which they can be maintained encourages proper, periodic care, thus assuring dependable operation in any emergency.

High Electrical Safety Factors Protect Linemen

Westinghouse reclosers and sectionalizers are designed and built by men with years of knowledge of circuit breaker designs. Tanks are heavy drawn steel with cast-iron covers. Only one operation is required to "lock out" when closed on a fault. And to pick up a line after lock out, this one operation is time delay — rides through inrush currents without unnecessary openings.

These Features Make for Easy Maintenance

Westinghouse reclosers and sectionalizers can be inspected and maintained right in the field — they're that simple! Pliers, screw driver and crescent wrench are all that's needed. Loosening four cover clamps permits quick inspection of contacts, tank liner and oil. Painting is never required—tanks and covers are galvanized.

Replacement Kits Cut Maintenance Cost

For parts that may need replacing, Westinghouse offers easy-to-use spare parts kits. The contact kit costs only $5.61 — *cheaper by more than $13.00 than any other contact replacement.* And it takes only 5 to 10 minutes to install — less than half the time required for other makes. Tank liner and bushing kits are equally economical. Tank liner is Micarta®.

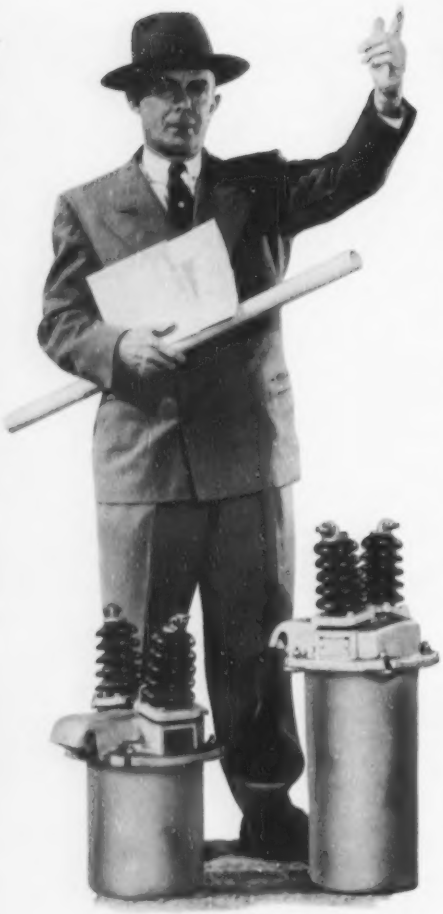
It will pay you to look over your automatic protective equipment now—*before* the lightning season strikes. For practical suggestions on recloser and sectionalizer maintenance, call your local Westinghouse representative.

Now, for a typical instance of the priceless ingredient Westinghouse offers . . . broad application experience . . . see the next page.

YOU CAN BE **SURE**...IF IT'S

Westinghouse

Proper coordination of protective devices means improved distribution reliability



Bob Longwell, Engineering and Service Manager, Chesapeake District, tells the story.

"A small utility in our area was having protection trouble. Loads had grown fast. The positioning and ratings of their automatic apparatus made proper coordination of protection difficult. As a result, power outages were too frequent and affected large areas.

"We had been over their system carefully — felt we knew the answer to their problems. Working closely with their engineers, we drew up a system-wide plan of coordinated reclosers, sectionalizers and fuses. Westinghouse engineers at East Pittsburgh checked and approved our proposals.

"The customer tested the plan on one-fourth of the system and was pleased with the results. Service continuity was notably improved — power outages localized. In fact, results were so encouraging that they have now carried out the plan 100%."

* * * *

Bob Longwell's story underscores this fact: It takes *more* than reliable equipment to make a reliable system — it takes skillful application engineering, too.

This priceless ingredient — born of years of experience in solving utility distribution problems — is yours through Westinghouse consulting and application engineers. There's a C&A engineer near you. He knows your distribution problems and how to solve them. And he is backed by all the engineering resources that Westinghouse commands. Contact your local Westinghouse representative for prompt C&A service.

CP-1013

YOU CAN BE **SURE**...IF IT'S

Westinghouse

Want detailed information?

Your local Westinghouse representative will be glad to provide it. Or fill in this coupon and mail to Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania.

Gentlemen: Please send literature checked below:

- ☐ Single-Feeder Unit Substations ..... DB 48-100
- ☐ Autotrol Capacitors ..... DB 49-310
- ☐ URL-16 Regulators B-5841
- ☐ "CSP" Distribution Transformers ..... DB 46-100 "CSP" / DB 46-110 "CSP"
- ☐ LX Lightning Arresters ..... DB 38-150
- ☐ DX Fuse Cutouts ..... DB 38-620
- ☐ Reclosers and Sectionalizers ..... DB 38-710 / DB 38-760
- ☐ Maintenance of GR Reclosers and GRS Sectionalizers SA-7359

Name_____

Title_____

Company_____

Street_____

City_____ State_____

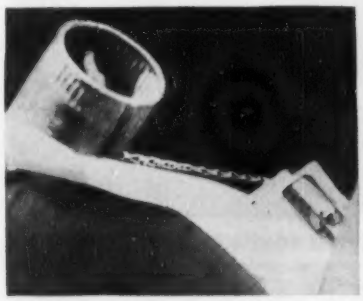
CP-1013

Glass Insulators

(*Continued from page* 116)

When a fault occurs on a line causing circuit breaker operation, the non-glass insulator nearest the fault fails about 30% of the time under the increased resurging power; the ordinary annealed glass insulator fails about 50% of the time; but the tempered glass insulators have never failed in five years of use.

The Keystone Heights area has extremely sandy soil, pocketed with lakes fed by mineral-free underground streams. This makes it most difficult to obtain satisfactory grounds.



CORRUGATED END of metal canister after copper wire was soldered inside end.

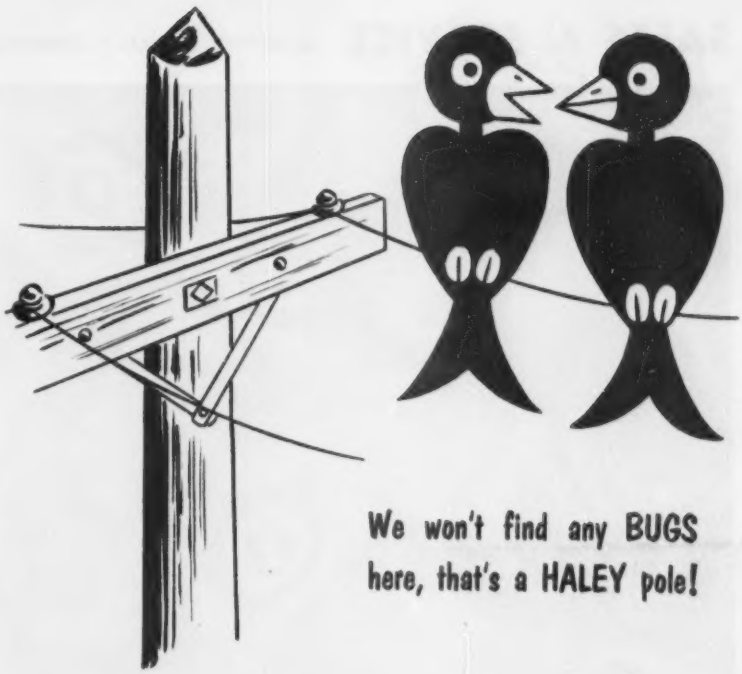
Modified Canister End Protects Hot-Sticks

R. A. YOUNGMAN, District Engineer, Appalachian Electric Power Co, Fieldale, Va.

Soldering a piece of No. 6 soft-drawn copper wire around the inside ends of galvanized, corrugated, 3⅞-in. ID canisters protects hot-sticks from surface gouges when they are inserted. The wire provides a smooth surface on which the hot-sticks can slide while being removed or replaced. Severe damage and considerable maintenance are eliminated.

The modification was made by garage personnel in a few minutes. No deterioration of soldered end of canister has been observed, evidently because it is protected from weather by a cover. Since the modification, field personnel report that hot-sticks are no longer damaged and their safety has been preserved. In addition, hours of hot-stick maintenance have been eliminated.

This modification of canisters was an expedient; specifications for new canisters require protection of hot-sticks from abrasion.



We won't find any BUGS here, that's a HALEY pole!

Haley's PENTAchlorophenol TREATED

CEDAR POLES AND FIR CROSS ARMS

Light in weight and clean. PENTAchlorophenol treated in our modern plant for protection against decay, moisture and insect damage.

TWO Strategically Located Yards
MINNEAPOLIS, MINNESOTA
FINDLAY, OHIO

R. G. HALEY & CO.
SPITZER BLDG. TOLEDO 4, OHIO

FOUR UNIT HEATERS mounted on the wall provide comfortable working conditions in garage located under railroad embankment. Units consist of resistance heaters and blowers

OFFICE COMFORT is provided by resistance heater suspended from the ceiling

Resistance Heaters Provide Garage Shop Comfort

Unit heaters, suspended from the ceiling, solved a difficult problem for Penn Truck Co of Indianapolis. Penn Truck operates an office and repair shop which are built under a railroad embankment.

A stack, for removal of the products of combustion of any type of flame fuel, was out of the question. At the same time, the several feet of earth, which surround office and shop, provide excellent insulation and heat losses are therefore very low.

There are four unit heaters in the shop and one panel heater in the office. Total connected load is 69 kw. Peak demand for the 1952-53 heating season was 54 kw. Kilowatt hour use following installation in October, 1952 and to the meter reading dates about the 18th of each month was:

Nov.	Dec.	Jan.	Feb.	March	April	May	June	Total
2,160	4,440	5,160	5,200	4,120	3,360	960	40	39,810

Ray Forbes, Jr, Indianapolis Power & Light Co electric heating specialist, reports that workers are enthusiastic about their comfortable working conditions and Penn Truck Co is happy with the low operating costs and with shop production.

$5 Million Asked for Detroit Street Lighting

The Detroit Public Lighting Commission has asked City Council approval of a 10-year, $5-million program for new lighting installations on city alleys, traffic and residential streets.

The ultimate requirements of the city, estimated by the commission to cost $11,600,000, would give Detroit ". . . ideal installation from an illumination standpoint," the commission said.

The initial program would provide $3-million for improved or new lighting on 190 miles of traffic streets, $1-million for residential streets and $1-million for alleys. At the present time the commission says there are only about 400 lights along the 1,500 miles of alleyways in the city. In addition, only 30% of traffic streets are now adequately lighted, another 24% were improved some 20 years ago and are now inadequate.

The remaining 288 miles of city streets are far below the ideal. The commission has been allowed only $100,000 a year over the past four years for residential street lighting.

Electromode Announces Ceiling Heating Cable

Addition of cable for radiant ceiling heating to its line of electric home heating equipment was recently announced by the Electromode Corp, Rochester, N. Y. The cable is available in measured lengths of specially constructed and insulated wires.

The cable is for embedding in the ceiling plaster, stapled to the rough coat and covered over by the finish layer. A feature claimed for the cable is elimination of any possibility of development of streaks on the ceiling.

Making the wires hum a more profitable tune

The Crosley Division and the Bendix Home Appliance Division of the Avco Manufacturing Corporation have been combined . . . thereby bringing about joint distribution and promotion for the widest product range in the home appliance industry.

This consolidation is now particularly important to you. Here is why:

In 1953, the margin of reserve of generating capacity rose to 17% for the country as a whole—and this year it will go beyond 20%!* Electrical power demands by home appliances will constitute the major load to be absorbed, and will comprise the greatest market for profitable exploitation.

Prior to World War II, appliances such as air conditioners, home laundries and dishwashers were rarely owned by the average householder. Now, however, not only are the usual refrigerators and ranges being bought in greater profusion, but these other *new* appliances are also being purchased . . . And Mr. and Mrs. Average American have the income and the inclination to buy them all!

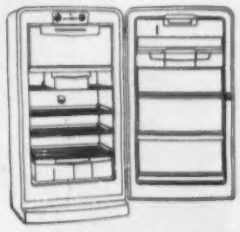
The Crosley and Bendix consolidation enables utilities to employ a single source for all kitchen appliances and home laundry display and demonstration requirements. Furthermore, Crosley and Bendix distributors will assist and fully cooperate with power companies in their promotional efforts.

May we suggest that you investigate how the Crosley and Bendix Home Appliance Consolidation can aid you in your area?

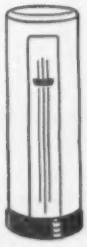
**data courtesy of E.E.I.*

Bendix Duomatic Washer-Dryer

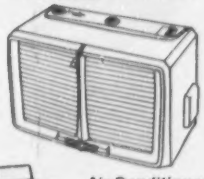
Range



Crosley Super Shelvador®

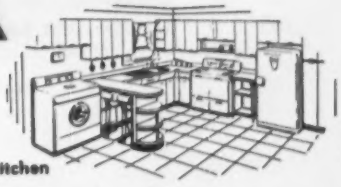


Water Heater



Air Conditioner

Dishwasher-Dryer



Kitchen

APPLIANCE AND ELECTRONICS DIVISION

CROSLEY (AVCO) BENDIX

APPLIANCES • TELEVISION • RADIO — **AUTOMATIC HOME LAUNDRY**

HELPING AMERICA LIVE BETTER—*electrically*

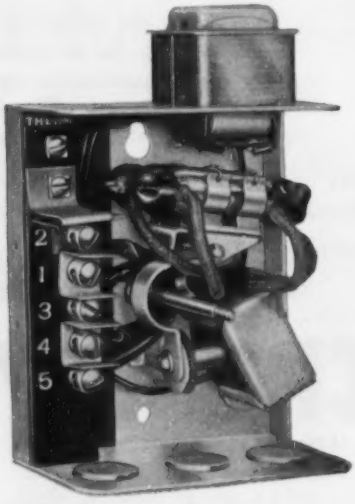
Now, from Honeywell

2 new thermostats for

1 *The Honeywell Round—with the new R879 quiet relay*

Here is a combination of controls ideally suited to utilize the full measure of comfort potentially available with electric radiant panel heating. This set includes the latest development in low-voltage thermostats, the Honeywell Round, plus a heavy-duty, *quiet* relay specially designed to carry high-amperage resistance loads characteristic of electric radiant panel heating applications.

The Honeywell Round is a new improved thermostat that matches any color scheme. Features include a "decorator ring" which can be removed for painting, an easier-to-read dial, a bimetal thermometer, an adjustable heater and dust-free mercury switch to cut maintenance costs.



The new R879 relay features heavy-duty, sealed-in mercury switches that are built to provide years of trouble-free operation. Switching action is obtained by a plunger-type solenoid having no metal-to-metal contact. Positive, silent switching is assured.

The relay is available in two models. The single mercury switch model (R879A) is designed to carry a single circuit, up to 20 amperes (4600 watts at 230 volts). The double mercury switch model (R879B) can handle *two* 20 ampere circuits.

electrical heating control

One of these two thermostats will solve your control problem—better, easier, more satisfactorily

2 *The new T429 is the finest thermostat for heavy resistance loads*

- **most accurate and responsive high amperage stat built**
- **ideally suited to electric radiant panel heating applications**
- **narrow operating differential of approximately one degree**
- **lasting, dependable MICRO SWITCH carries 4,000 watt electrical rating at 230 volts**

The T429A represents the *finest* in thermostats built for heavy resistance loads. It is a special development of the Honeywell TA42—one of the most widely-used line-voltage thermostats in service today.

The specialized engineering talents of Honeywell and its MICRO SWITCH Division were combined to incorporate *all* the features the heating industry has been looking for in a heavy-duty thermostat. The new Honeywell T429A features *ample capacity . . . exceptional responsiveness . . . lasting performance.*

The T429A Thermostat, because of its close operating differential, is especially suitable for control of electrical radiant panel heating, electrical strip heating, and other space-heating applications.

The Honeywell MICRO SWITCH incorporated in this thermostat will directly control resistance (heater) loads up to 4,000 watts at 230 volts.

For complete information on electrical heating control applications of the T86 Honeywell Round Thermostat, the R879 relay and the T429 thermostat, write to Honeywell, Dept. ET-2-36, Minneapolis 8, Minnesota.

MINNEAPOLIS **Honeywell**

104 OFFICES ACROSS THE NATION

H HONEYWELL *First in Controls*

UNIFORM GLARELESS LIGHT is provided in main banking room by luminous ceiling. New installation accomplishes both lowering of ceiling and improved lighting

Luminous Ceiling Solves A Problem

JOE W. PARRIS, Advertising Dept, Georgia Power Co, Atlanta, Ga.

A new luminous ceiling installation at the First National Bank of Thomson, Ga. accomplished a dual purpose. It provided greatly improved lighting and solved the problem of lowering the existing ceiling.

According to M. M. Kimbrel, executive vice president, the bank is "sold" on the following merits of the new lighting system:

1. The light is uniformly distributed across the ceiling.
2. Diffused light is soft and glareless. Provides better working conditions.
3. It is more comfortable—eye fatigue, mental fatigue and general fatigue are reduced.
4. Fewer errors are made—employees are kept at a higher peak of efficiency for a greater part of the day.
5. There is a stimulating effect on the morale.

"These have a definite bearing on our operating costs. Power costs are slightly increased, but the added performance of useful work more than offsets these additional power costs. The humanitarian benefits to our employees also appear to be well worth the higher cost of installation."

"Comment from our customers has been very favorable. The soft, even light provides a pleasant atmosphere and generally improves their spirit. The attractive lighting makes for better customer service and is especially conducive to good customer relations."

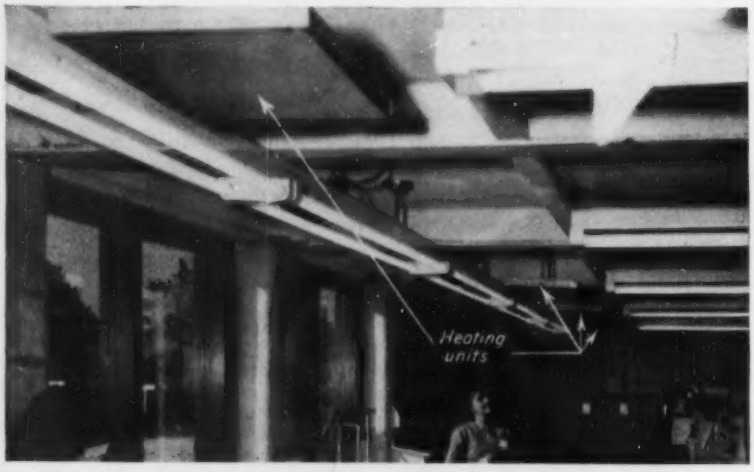
"So far, we are convinced this is one of the finest improvements included in our recent remodeling."

Footcandle illumination in center lobby is 70, with 60-65 ft-c at tellers' windows. Desks along walls have 50 ft-c. Installation has 14 - 96-in. and 42 - 72-in. T-12 slimline lamps above the Wakefield plastic ceiling. Lamps are in continuous rows across entire width of room using 3 - 72-in. and 1 - 96-in. lamp in each row. Rows are 3 ft apart. Connected load is 4,164 w. Original ceiling height of 20 ft was lowered to 13 ft 6 in. by new ceiling.

F Lamp Makes Colors Truer, Company Claims

Reds look redder, greens appear greener and blues are bluer, claims the Duro-Test Corp in announcing its new Super Deluxe 45 fluorescent lamp. The new lamp is said to incorporate a revolutionary neutral light source in the upper limit of the visible wave length region, producing true color rendition throughout the visible spectrum.

Production of the lamp in all regular fluorescent sizes is now under way, according to Walter H. Simson, president. He anticipates that this new color will receive enthusiastic acceptance from fluorescent lamp users.



Glass Panels Heat Nursery Sales Room

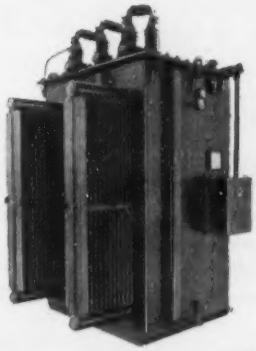
Hillside nursery, just outside of Indianapolis, and a customer of Indianapolis Power & Light Co, has found the close temperature control of glass panel radiant heating ideal for their sales area. With 19 kw of heating in the bulb sales room, and the thermostat set at 60F, bulbs are kept dormant. At the same time the area is comfortable for workers who dress for this temperature.

Operating costs are reasonable, the customer reports. He has said he is well satisfied with results.

ALLIS-CHALMERS
5/8% STEP
VOLTAGE REGULATORS

Practically NO WEAR

AFTER 1,240,000 TAP CHANGES!



Three-Phase
Power Regulator

Single-Phase
Power Regulator

Single-Phase
Distribution Regulator

The unretouched photo above shows the excellent condition of the tap changer from an Allis-Chalmers power regulator after 17 years' operation.

This power regulator on a western utility was disassembled to permit replacing gaskets that were installed when the unit was built in 1937. After thorough inspection the unit was placed back in service.

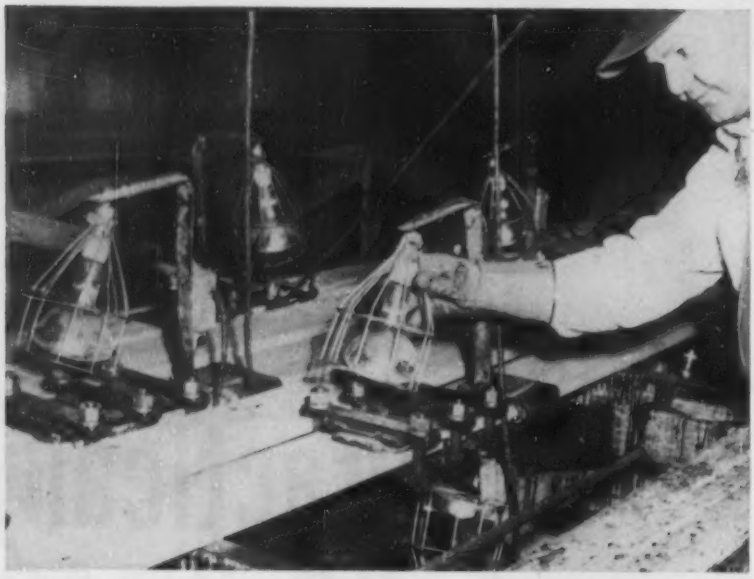
This 17-year operating record adds field proof to the laboratory tests that have shown that the *Quick-Break* mechanism of Allis-Chalmers 5/8% step regulators will stand up under five million operations. You get reliability like this in Allis-Chalmers 5/8% step regulators because the *Quick-Break* mechanism is used in all of them. It provides fast, clean contact separation, snapping moving contacts from one contact to the next before there is time for damage to occur.

Get more information. It will pay to get complete facts on this rugged, reliable tap-changing mechanism. Contact the nearest A-C district office or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4241

ALLIS-CHALMERS

Originators of 5/8% Step Regulation

INDUSTRIAL APPLICATIONS



GLUE CURING at section joints in thin oak wood, with pair of infrared lamps mounted on brackets directly to clamps, eliminates handling. Each completed length is glue cured in 30 min

Infrared Lamps Cure Glue Rapidly

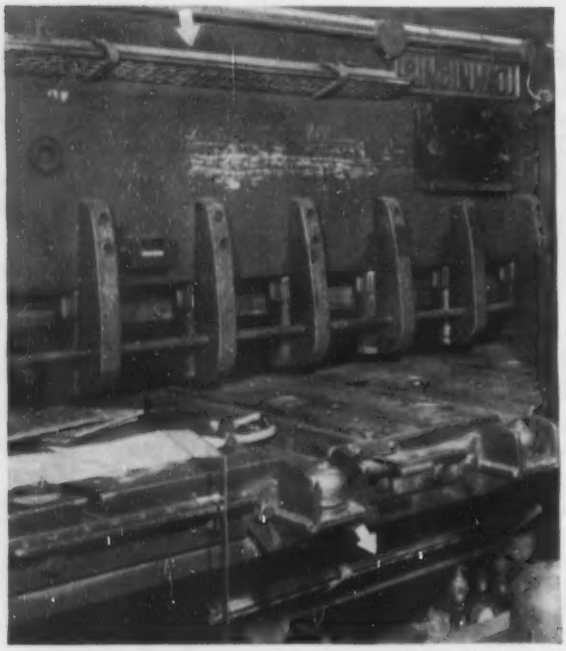
L. B. REED, Industrial Heating Consultant, Business Agent's Division, Dept of Water and Power, City of Los Angeles, Cal.

At the Wilmington Boat Works, Los Angeles, Cal., an economical method of rapidly curing glue with infrared lamps was utilized for a limited production run. The small investment in infrared lamps paid for itself many times over. In the mass production of several new all-wood minesweepers, the keel and longitudinal members, some as long as 70 ft, had to be built up of thin oak sections available only in 4-ft to 6-ft lengths. These short pieces were glued end to end to make up completed lengths before laminating to required thickness.

Owing to space restrictions and production schedule demands, each completed length had to be cured within 30 min. Although expensive dielectric heating could cure glue in seconds, a limited production run did not justify its use. Fifty-four pairs of infrared lamps, 250-w per lamp, proved effective and economical.

To turn out a completed length, each of the short pieces was first placed in a jig and scarfed. All the short pieces required for the specified structural length were then assembled on a special bench, the glue applied, and clamps were placed over each joint.

The glue at each joint was then cured by two 250-w infrared lamps; one lamp applying heat at the top of the joint, the other at the bottom. A pair of lamps was mounted by means of brackets on each clamp. After curing, the long pieces were laid on a die having the required contours. Lamination to the proper thickness was then possible.



Edwin L. Wiegand Co

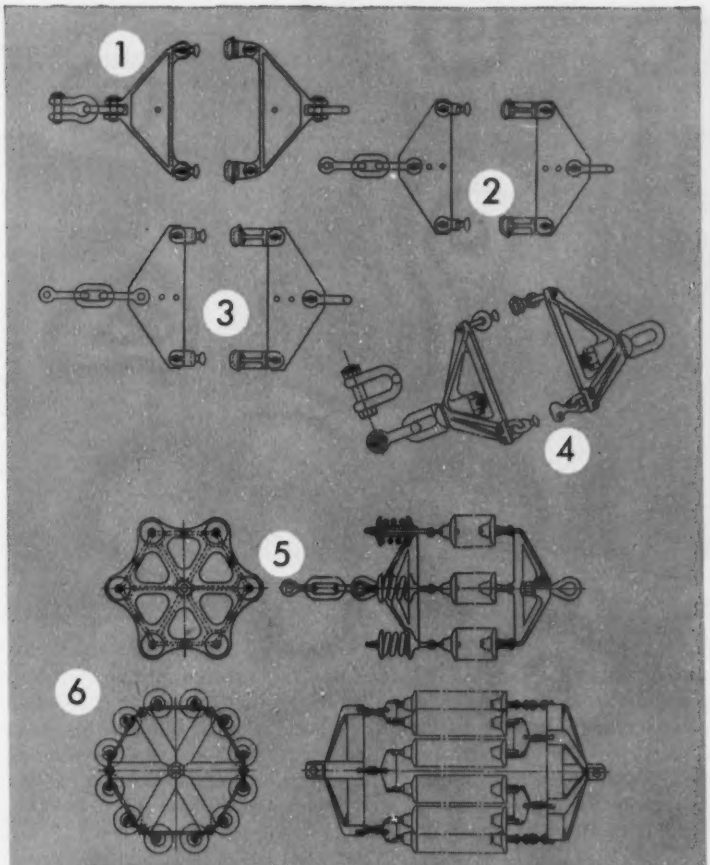
WARMING HANDS AND FEET of metal workers at their shearing job by radiant heaters eliminates time lost warming up around salamander stoves. Operating cost is less than with coal or wood

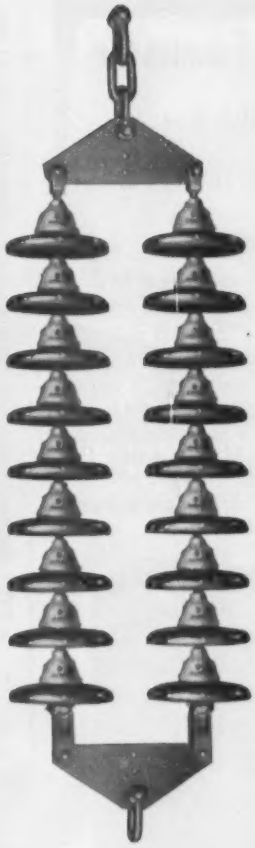
Space Heaters Provide On-the-Job Comfort

Sheet metal workers are kept warm right at their shearing job by means of electric radiant comfort heaters at a Middle West steel warehouse. Five compact heating units, mounted on the presses, focus gentle heat on hands and feet of three operators.

Men appreciate the continuous comfort provided on-the-job by radiant heat. Company also gains—by eliminating time lost previously by frequent trips to warm up around salamander stoves.

Company reports that operating cost of electric heating method is less than cost of run-of-mine coal and scrap wood used in salamanders for same purpose. With radiant heaters, heat is aimed at exact spot with little waste. The radiant heat cuts through drafts.





LET'S TEAM UP ON YOUR YOKE!

1. Light Duty Malleable Iron Double Strain Yoke
2. Medium Duty Steel Double Strain Yoke
3. Heavy Duty Steel Double Strain Yoke
4. Triple-string Yoke
5. Six-string, Spring-equalized Yoke
6. Twelve-string, Lever Load-dividing Yoke

Working together, we can solve your problems in dead-end construction for extra-heavy-duty spans. The job doesn't come up often, and so most power companies don't have a great deal of past experience to draw upon to get it done. Our Ohio Brass engineers do have that sort of experience. Being manufacturers of suspension insulators, we have just naturally been drawn into innumerable high-strength dead-end jobs, and the experience we've gained is at your disposal.

As a result of much work with this sort of dead-end, O-B has been able to prepare several standard sets of hardware to meet most multiple-string dead-end applications. More frequently, however, those using more than six strings of insulators require special engineering treatment. In cases like this, O-B is well prepared to work once again at a now (to us) familiar job.

Let's team up on it when, if ever, you need an unusual yoke design!

Ohio Brass

MANSFIELD OHIO, U.S.A.

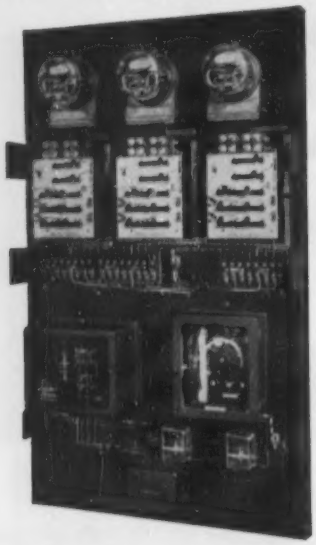
IN CANADA: CANADIAN OHIO BRASS CO., LTD., NIAGARA FALLS, ONT.

4436-H

Transformer Loss Compensator

Saves you Money!

SPECIAL FEATURE: It saves you money because it provides an accurate means of measuring the energy and demands of high-voltage services at the low-voltage side of the transformer.



THE TESCO compensator adds to the registration of the watthour meter an amount equal to the sum of the iron and copper losses of the transformer bank. It may be used with practically any type of watthour meter and . . . importantly . . . no changes are made in the meter itself, either structurally or in adjustments . . . It is produced with two and three element types for use with two-element or three-element meters on any type circuit.

Some of the Users . . .

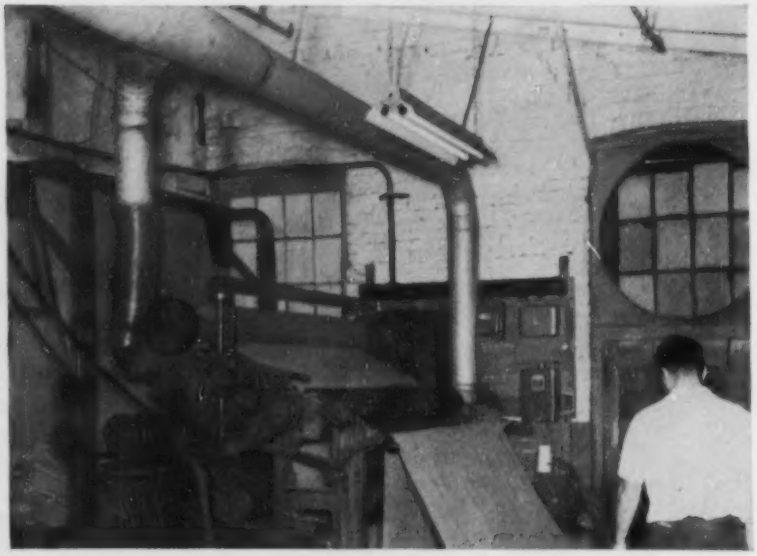
Phila. Electric Co. Penna. Power & Light Co. Texas Power & Light Co. U. S. Bureau of Recl. Public Service Co. of New Hampshire. Utah Power & Light Co. Northern States Power Co.

Get your book now FREE

Detailed information on operation, installation, applications. Write for Bulletin NO. 63-A.

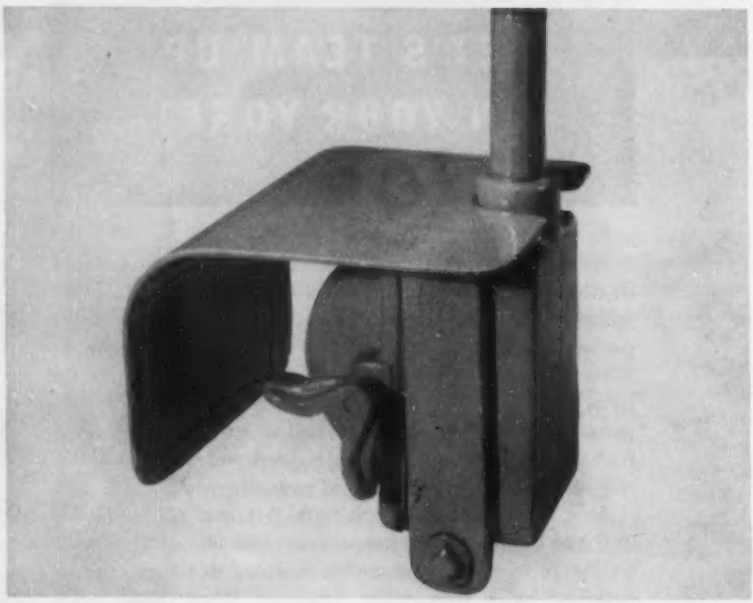
EASTERN SPECIALTY CO.

PHILADELPHIA 40, PA.



Electrical Ventilation Serves Dual Purpose

Electric Ventilation at Frankford Woolen Mill, Inc, Philadelphia, Pa., removes lint from shearing machines during cloth finishing process before it can contaminate the air. At the same time the lint is salvaged for distribution to manufacturers of roofing papers. Since installation of the fans and duct work, employees do more and better work because of the pleasant working atmosphere created by clean cool air. The ventilation also cuts down materially the spoilage by dust and aids building maintenance efficiency. L. Albertson, Philadelphia Electric Co, Philadelphia, Pa.



Guard Protects Switch

Butterfly Guard doubly protects switch against overhead leaks and falling objects. It prevents accidental starting of equipment due to body contact with switch lever. E. I. Du Pont De Nemours & Co, Inc, Cleveland, Ohio Plant.

Protect

YOUR LINEMAN
AS WELL AS
YOUR LINE WITH

BLACKBURN
Aluminum
FITTINGS

Time-Tested in Field Operation

NO HAZARDOUS TOOLS REQUIRED

When that storm emergency call comes through, linemen appreciate the easy, safe way they can install BLACKBURN Aluminum Fittings with their standard hand tools.

Engineers and operating men can specify BLACKBURN Aluminum Fittings with confidence because they:

- Protect conductors, by distributing unit pressures over large area.
- Provide wide separation of dissimilar metals—insuring against galvanic corrosion.
- Are made with corrosion resistant alloys.
- Are time tested in field operation under all weather conditions.
- Available in varied designs as illustrated.

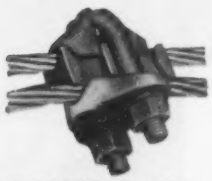
Send for free literature and samples

Available through electrical wholesalers everywhere

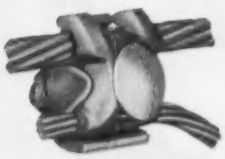
JASPER BLACKBURN CORPORATION
35 Madison St. • St. Louis 6, Mo. • *Phone:* CEntral 3007

TYPE PAA-400
For Aluminum Conductors through 400 MCM

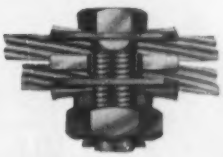
TYPE PAC—For Aluminum Conductors through 336.4 MCM; Copper through 2 str.



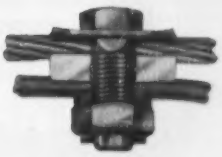
TYPE DLC—For Aluminum Conductors through 1/0 ACSR



TYPE PAA—For Aluminum Conductors through 336.4 MCM



TYPE AAW—For Aluminum Conductors through 4/0 ACSR



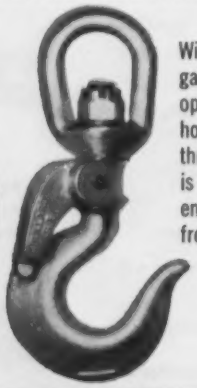
TYPE CA—For Aluminum Conductors through 4/0 ACSR; Copper through 4/0

PROTECTION – WHERE ACCIDENTS BEGIN

BULLARD-BURNHAM SAFETY HOOKS

At last a 100% safe hook for every type of equipment; utility and chain hoists, horizontal tuggers, come-a-longs, cranes, block and tackle or snatch blocks. Safety gate automatically locks closed and cannot be disengaged accidentally. A touch of the finger releases the lock to open gate. If the hook is sprung, even ¼ inch, gate will swing free, warning workers. All hooks used are standard drop forged hooks with B & B safety gates of non-corrosive brass. Sizes available #2 through #16A. Return spring on gate is available at additional cost. Write for descriptive circular.

E. D. BULLARD CO.
SINCE 1898
SAFETY HOOK DIVISION
275 EIGHTH STREET
SAN FRANCISCO 3, CALIF.



With gate open hook's throat is entirely free

EVERYTHING BULLARD IN SAFETY

T. M. REG. U. S. PAT. OFF.

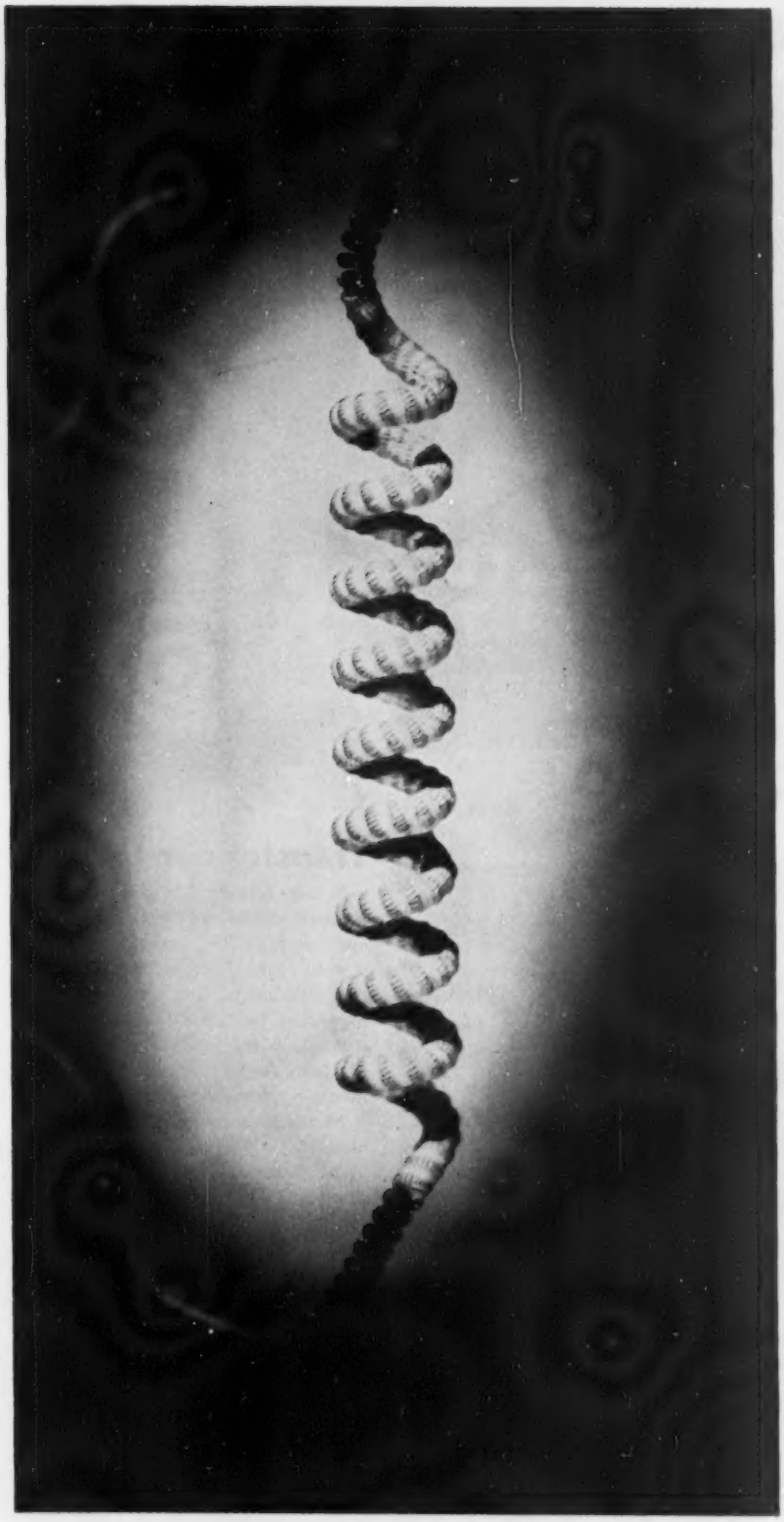
INDUSTRIAL BRIEFS

Heating tanks (used for recharging CO_2 fire extinguishers) with 8—250-w infrared lamps at C. I. Thornburg "Citco" Co, Huntington, W. Va., has eliminated need for enlarging present overloaded hot water supply system, including extensive plumbing and catch basins. Absence of hot water has reduced maintenance and increased efficiency. Formerly, the tanks were heated by draining hot water over them. The heating increases the pressure in the tanks. R. W. Hinshaw, Power Engineer, Appalachian Electric Power Co, Huntington, W. Va.

Dehumidifying storage basement of Riverside Shoe Corp, Millersburg, Pa., has eliminated damp condition and provided a dry storage place for finished shoes and leather products. Formerly, nails in shoes rusted. Several humidifiers were installed in the basement and one in the office with a total load of 1,000 w. Joe Mumma, Industrial Power Representative, Pennsylvania Power & Light Co, Harrisburg, Pa.

Heating plastic in automatic molding machine at the Pitt Mfg & Distributing Co, Pittsburgh, Pa., using 8.8 kw of strip heaters for making wall tile, provides precisely controlled heat and pressure to duplicate results time after time. Rejects are practically non-existent. Plastic pellets (¼ in. diam) are weighed automatically, dropped into electric heating chamber, then into molds where pressure is applied by 25-hp motor to form tile. E. E. Ritts, Industrial Sales Representative, Duquesne Light Co, Pittsburgh, Pa.

Space heating office rooms electrically readily solved a space heating problem at Ohio Farmers Grain Corp, Fostoria, Ohio. Four 1.35-kw space heaters were installed in "hard to heat" places as auxiliary heaters. Since installation of space heaters, employees have had no difficulty in keeping warm when regular heating system was not operating during cool spring and fall weather and during morning hours before heat finally gets around to difficult-to-heat parts of office. R. T. Woodruff, Industrial Power Engineer, Ohio Power Co, Fostoria.



New twist on old idea makes G-E fluorescent lamps last longer

ONE of the most important materials in a fluorescent lamp is the little bit of chemical at each end of the tube. The current flows through it, electrons flow out, and the lamp starts to glow.

The old idea was to hold the chemical on a double-twisted wire coil. General Electric's new idea was to go that one better: give the wire a *triple* twist. This not only holds more chemical, it also holds it longer.

The result of course is longer lamp life and more light for your money.

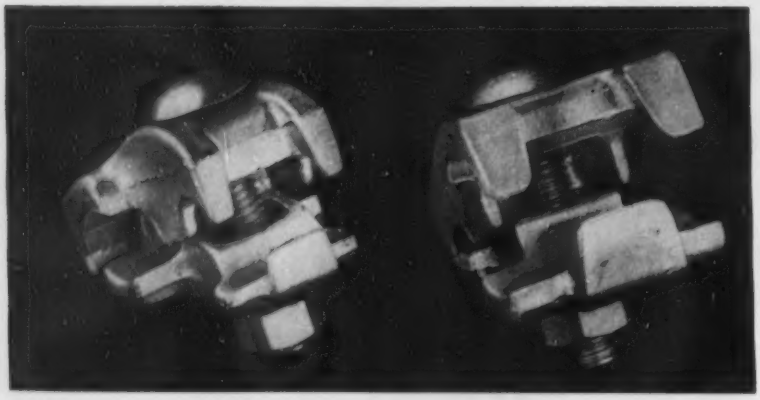
General Electric's triple coil is used in G-E slimline and other G-E instant-start lamps. Just one more example of why...

You can expect the best value from General Electric fluorescent lamps

You can put your confidence in—

GENERAL ELECTRIC

NEW EQUIPMENT



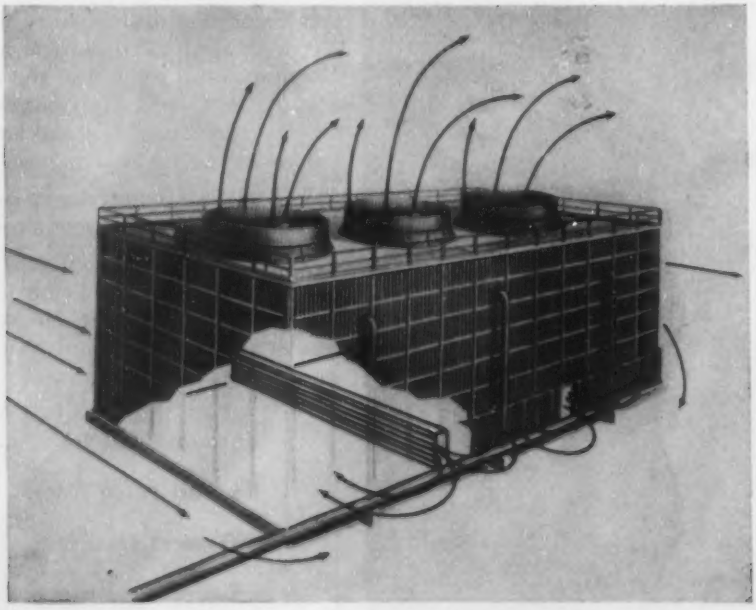
Aluminum Connectors

Two single-bolt, parallel-groove connectors recommended for ACSR, aluminum, and Amerductor are designed for maximum contact surface in the cable grooves. Interlocking fingers on both top and bottom members are designed to enclose both main and tap.

Bolts are said to exert straight pressure without distortion regardless of cable size combinations and are hot-dip galvanized steel or high-strength aluminum with Alumilite finish. Top and bottom members are made of high-strength cast aluminum alloy, heat treated.

Type LC-51C will accommodate No. 8 to 1/0 ACSR. Type LC-81A accommodates No. 8 to 1/0 ACSR with armor.

Anderson Brass Works, Inc, 700 N. 41st St, Birmingham, Ala.



Cooling Towers

Recirculation of exhaust air from cooling towers has been reduced by using equalizing channels between each cell of the tower. During strong horizontal winds the channels allow air to pass completely through the tower. This relieves the pressure differential existing between the windward and leeward sides and reduces the possibility of recirculating exhaust air.

Santa Fe Tank & Tower Co, 5401 S. Boyle Ave, Los Angeles 58, Calif.

Transformer Gin

A new transformer gin, Model 30, is made of Owens-Corning Fiberglas and has high electrical resistance. It is said to be light, strong, safe, and nearly indestructible. A simple pivot mounting permits the gin to swing sufficiently for installation of a bank of three transformers from a single mounting position.

Model 30 is designed for a working load of 3,000 lb, and each gin is said to be shop tested to 4,500 lb before shipment. Total weight of the gin is about 35 lb.

Petersen Engineering Co, Santa Clara, Calif.

Station Arresters

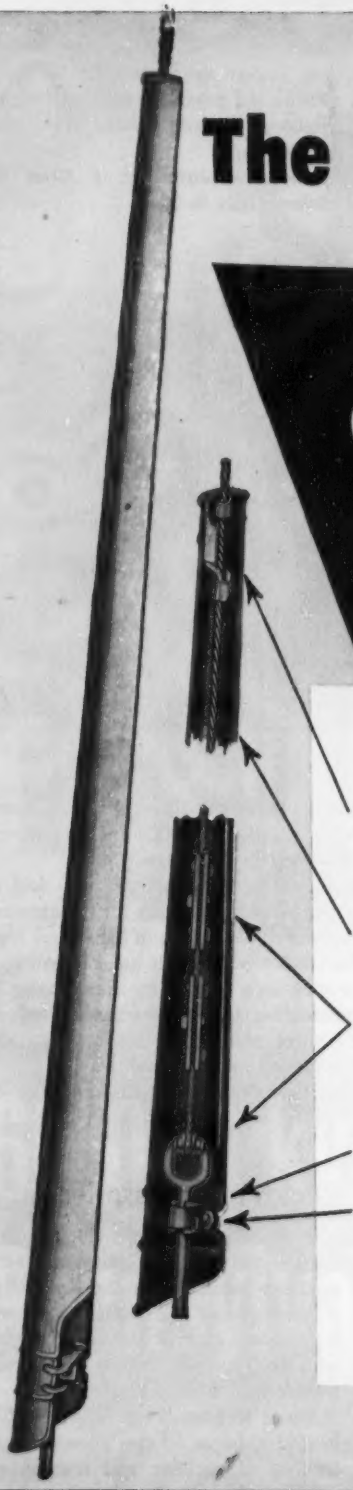
A new station-type lightning arrester, rated from 3 to 264 kv, is said to attain 20% lower IR discharge voltage, 10% lower sparkover voltage, and three times greater discharge capacity and endurance than the previous model. The arrester combines magnetic action of a gap unit with Thyrite valve action.

Gap unit includes parallel sets of gap electrodes connected in series

The HUBBARD LOXFAST

5 POINT Guy Protector

HOT GALVANIZED



1. Top clamp fits strands ½-inch in diameter and under, no bolts to tighten.
2. Turned edge, full length, gives rigidity.
3. Anchor rod eyes and guy clamps completely encased.
4. Beading for extra strength.
5. Clamp takes rods 1¼-inch diameter and under, one bolt action.

THERE is only one bolt to tighten when installing the Loxfast. The top clamp on the Hubbard Loxfast is boltless. It is attached first by hooking over the guy wire. A single bolt makes the bottom clamp fast around the anchor rod after the Loxfast is properly lined up. Loxfasts don't rattle in wind or storm. There's extra strength, extra appearance and economy of shipping and storing space in the tapered design. There's extra strength, too, in the turned edges and bottom beading. There's high visibility in the bright, double-dip galvanized surface; the 8-foot Loxfast exposes 360 square inches to view from a single point of vision. The Loxfast is installed in minutes, for long years of service.

HUBBARD AND COMPANY

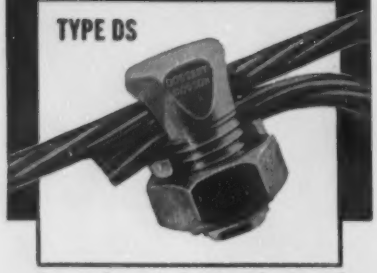
ESTABLISHED 1843

PITTSBURGH • CHICAGO • OAKLAND, CALIFORNIA

"Hang the Load on Hubbard Hardware!"

DOSSON SERVICE CONNECTOR

TYPE DS



Proven by actual test and years of operation under all climatic conditions to permanently connect two wires with greater security and tightness. For quick, efficient connections of solid and stranded conductors in sizes No. 14 to 1000 MCM. High contact pressure between conductors assures trouble-free performance.

1. High translation of torque by low coefficient of friction
2. High contact pressure
3. Free from vibrational loosening
4. Withstands high tightening torque
5. Maximum contact area
6. Made of high strength "DURONZE" alloy
7. Better conductivity
8. High corrosion resistance
9. Economical—can be used over and over again
10. Dossert precision-manufactured

IMMEDIATE DELIVERY!

DOSSERT REPRESENTATIVES IN THE FOLLOWING CITIES:

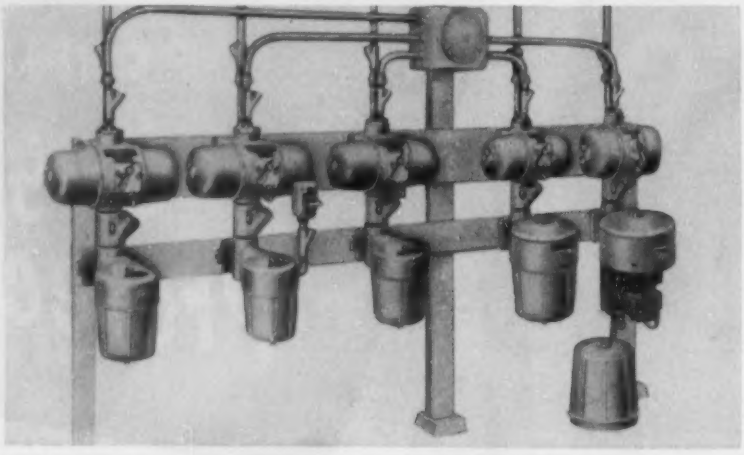
Atlanta, Georgia
Bay City, Michigan
Boston, Massachusetts
Carnegie, Pennsylvania
Cincinnati, Ohio
Cleveland, Ohio
Columbia, South Carolina
Dallas, Texas
El Paso, Texas
Kansas City, Missouri
Knoxville, Tennessee
Lakewood, Colorado
Little Rock, Arkansas
Minneapolis, Minnesota
New Orleans, Louisiana
Omaha, Nebraska
Philadelphia, Pennsylvania
Richmond, Virginia
St. Petersburg, Florida
St. Louis, Missouri
San Francisco, California
Seattle, Washington
Williamsville, New York

DOSSERT MFG. CORP.
249 HURON STREET, BROOKLYN 22, N. Y.
SINCE 1904

with magnetizing coil and has a lightning sparkover path across one gap and arc-interrupting path across as many as 14 multi-gaps. Sparkover sensitivity is said to be controllable independent of arc-interrupting efficiency.

Thyrite disks have been improved to provide low resistivity and high discharge capacity. Internal elements are sealed in super-dry atmosphere within the porcelain housing. Thyrite resistors control voltage distribution across gaps.

General Electric Co, 1 River Rd, Schenectady 5, N. Y.



Breaker and Starter

A new line of explosion-proof, dust-tight, rain-tight circuit breaker, motor starter, and line starter combination enclosures, called Unilets, are UL approved. With a sealing Unilet enclosures may be joined in combination.

Unilets possess full seven-thread engagement at the coupling joints and on the bolt-free covers. Safe entrance to individual motor starters for maintenance is said to be assured in both single and banked combinations in hazardous areas without shutting off other branch circuits. No "live" circuit breaker wires are exposed while motor starter enclosure is open on a line starter combination.

Other features include lightweight construction and straight-through wiring. The Unilet line covers breaker-starter control equipment rated to 225-amp breaker loads and to 100 hp on 3-phase induction motors at 600 v.

Appleton Electric Co, 1701-59 Wellington Ave, Chicago 13, Ill.

Magnetic Relay

A magnetic relay has been designed for use with single phase capacitor start motors requiring a voltage-sensitive relay to disconnect the start winding or reduce the capacitance when the motor approaches full speed. Double break, silver-to-silver contacts on the single pole, normally-closed relay can handle start winding currents up to 50 amp on 115 v motor and 35 amp on 230 v motor.

The clapper-type magnet is designed with a permanent air gap, a knife-edge bearing, ground sealing surfaces, and a heavy shading coil, for long life and quiet operation.

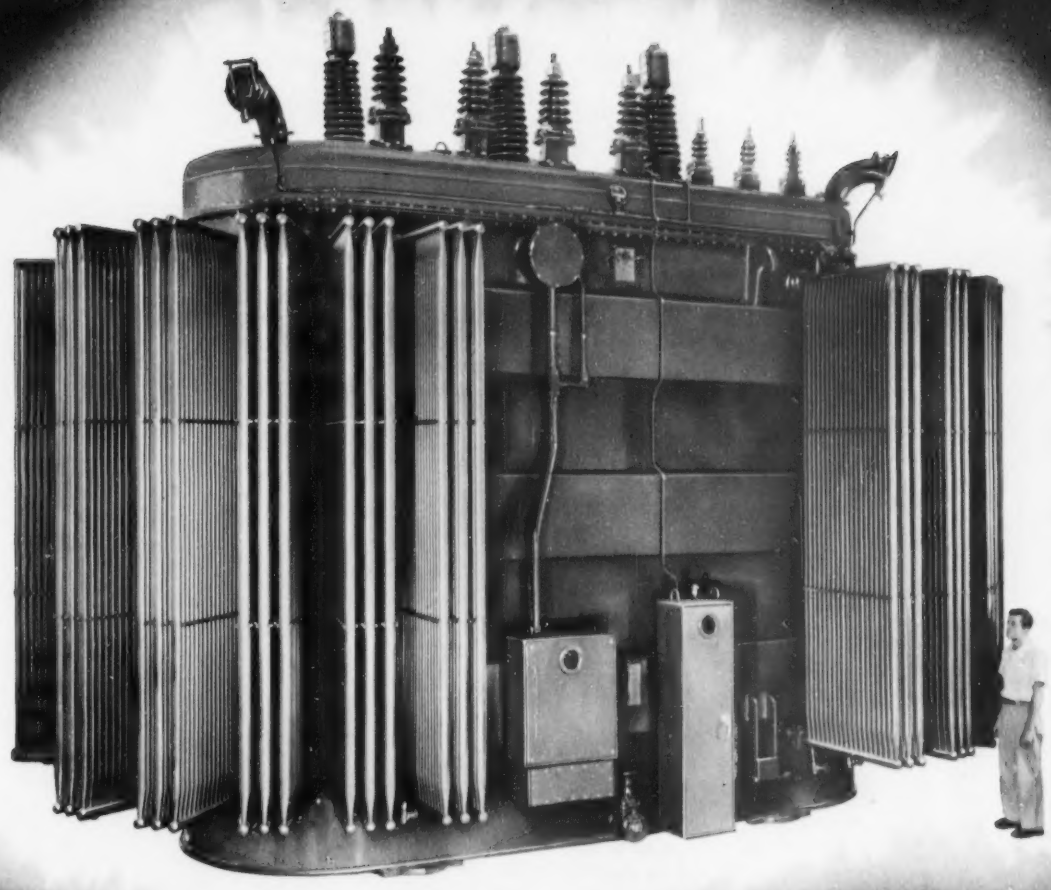
Square D Company, 4041 N. Richards St, Milwaukee, Wis.

Recloser Accessories

A shunt lockout solenoid, auxiliary switch, and shunt or relay trip solenoid are available for the Kyle Type R, three-phase, oil circuit recloser. An instrument control cabinet for use with the Type TR, three-phase current transformer is also available.

Shunt lockout solenoid, rated 120 or 240 v, 50 or 60 cps, allows remote lockout of recloser and manual reclosing of operating handle. It is factory installed, and electrical connections are made in a weather-proof terminal box.

Auxiliary switch, rated 115 v at 30 amp or 230 v at 15 amp, is factory installed on the recloser head and linked to the recloser mechanism. It



60,000 kva *THREE PHASE*
Pennsylvania Auto Transformer

This Pennsylvania auto transformer will transmit voltage from a 110,000-volt system to a 45,000-volt system and also supply station service power at 13,200 volts. The transformer is rated at 60,000 Kva, with provisions for future fans to increase the rating to 75,000 Kva.

PENNSYLVANIA TRANSFORMER COMPANY

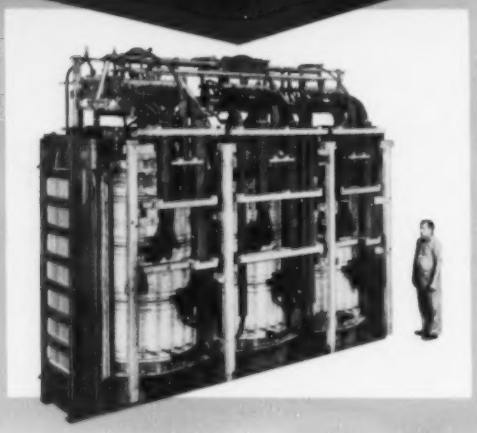
A McGraw Electric Company Division

CANONSBURG, PA. • Greater Pittsburgh District

SEE NEXT PAGE FOR INSIDE STORY

Inside a 60,000 kva THREE PHASE Pennsylvania Auto Transformer

60,000 Kva, Self-cooled. Three phase, 60 Cycles, 55°C. Temperature rise. High Voltage: 110,000Y/63,510 volts. Low Voltage: 45,000Y/25,980 volts. Tertiary Voltage: 13,200 Delta volts.



HIGH VOLTAGE SIDE OF TRANSFORMER →
Two sets of taps per coil assure excellent electrical and mechanical balance in the windings. Leads are connected to straight line tap changers through heavy pressboard tubes. Tap changers are mounted above core and coil unit where they are accessible through manholes in the tank cover.

Line ends of coils are heavily insulated to provide extra protection against surge voltage stresses.

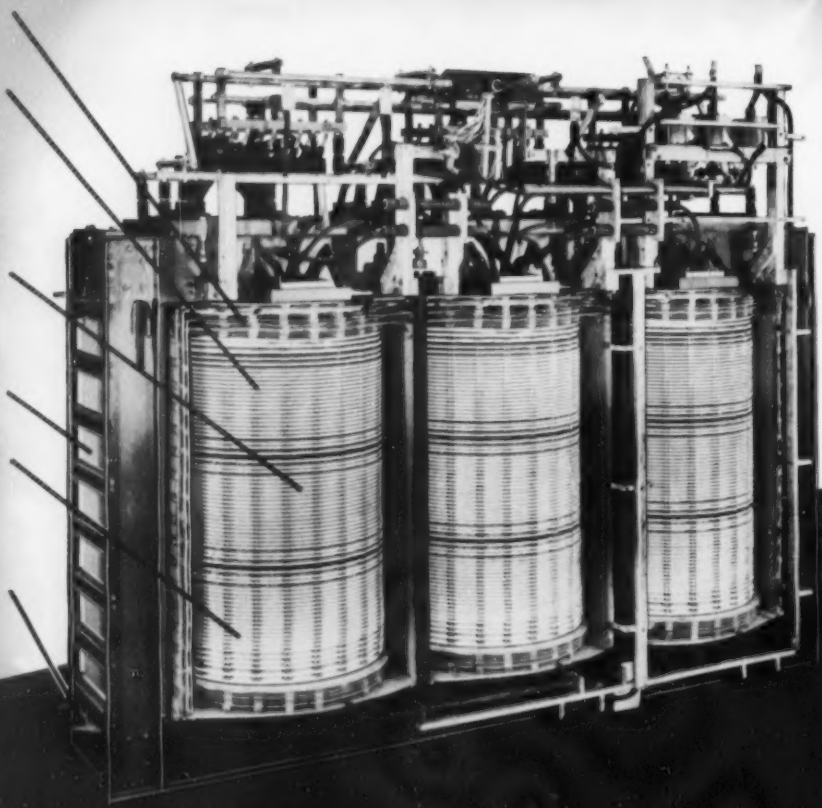
Coils are precompressed with a force equal to the highest short circuit stress and built into transformer at the compressed dimension. This prevents mechanical distortion of the coils if short circuit stresses occur.

Circular coils electrically balanced both radially and axially against short circuit stresses.

Five-legged core reduces height of transformer.

Continuous pancake windings in High Voltage coils. Helical windings in Low Voltage coils.

Guide plates fix the position of the core and coil assembly in the tank.



PENNSYLVANIA TRANSFORMER COMPANY

A McGraw Electric Company Division

CANONSBURG, PA. • Greater Pittsburgh District

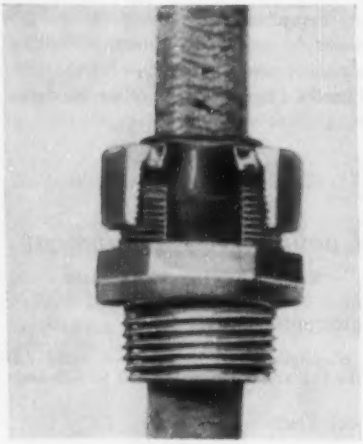
FOR EXTERIOR VIEW OF THIS TRANSFORMER, SEE OTHER SIDE.

may be a one, two, or three-stage unit for remote position indicating and for switching. Two contacts per stage can be set for either A or B operation.

Shunt or relay trip solenoid, rated 80 to 130 v, 50 to 60 cps, may be factory or field installed in place of the ground trip solenoid. It operates the recloser and supplements normal series overcurrent tripping. Clearing time of recloser with solenoid energized is four cycles maximum. Reclosing time is two sec for overcurrent or shunt tripping.

Instrument control cabinet contains an ammeter, transfer switch, and a shorting switch for ground trip solenoid. Cabinet is stamped steel, has a hinged weather-proof door, and has multiple conduit knockouts on its bottom. Ammeter scale ranges are 0-200, 0-270, 0-300, or 0-400 amp.

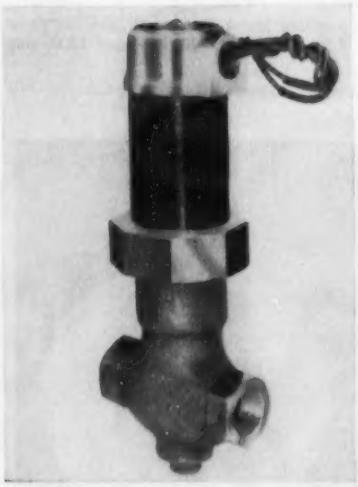
Line Material Co, 700 W. Michigan St, Milwaukee 1, Wis.



Weathertight Connector

A connector fitting, designed for watertight entrance cable protection, features a conical ring which pulls up tight under hex-nut or two-screw compression fitting. This seals a tapered Neoprene bushing around the cable. The connector fits ¾ to 1¼-in. hub or knock-out and cable sizes from two No. 10 conductors to three No. two conductors.

M & W Electric Manufacturing Co, East Palestine, Ohio



Solenoid Valve

Cast iron and cast steel solenoid valves are designed for handling media normally injurious to bronze or brass but not to ferrous metals. They are available in sizes from ½ to 2 in., and pressures range to 1,000 psi at 200 F, 500 psi at 450 F.

Features include stainless steel hooded pilot seat screw for positive closing action and Teflon disks inert to all media except hot fluorine. Neoprene rings seal joints and prevent leakage.

Atkomatic Valve Co, 545 Abbott St. Indianapolis 25, Ind.

Volt-Ammeter

An ac volt-ammeter, with ranges of 0-100/250/500 ma, 0-1/2.5/5 amp, and 0-15/30/75/150/300 v, is said to have an accuracy of 0.05% over the entire audio range. The instrument makes use of the null principle and has no deflection pointer.

Its thermal converter element may be replaced without changing the instrument's calibration. Protection against burnout is provided by a rectifier instrument that is connected in

TAILOR-MAKE YOUR OWN

CONDUIT OR PIPE BENDS

RIGHT ON THE JOB

...simple, quick with the GREENLEE HYDRAULIC BENDER

Yes, quickly make bends *exactly* as you want them, when you want them, where you want them. Compact, portable Greenlee Hydraulic Pipe and Conduit Bender lets you do this in a jiffy. *One-man operated* to produce smooth, accurate bends in just a few minutes . . . in pipe up to 5", rigid and thin-wall conduit, tubing, bus-bars. Owners report timesavings up to 60% and more, elimination of cost for manufactured bends and fittings, and "clean", tailor-made installations every time. Get facts now on this time-saving tool that often pays for itself on first few jobs! Write for free Bender Booklet, Greenlee Tool Co., 1802 Columbia Avenue, Rockford, Illinois.

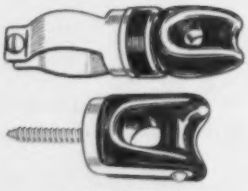
GREENLEE

Other GREENLEE timesaving tools for electrical work: Hand Benders; Joist Borers; Cable Pullers; Knockout Tools; Auger Bits and Drills.

Buy with confidence from a single source

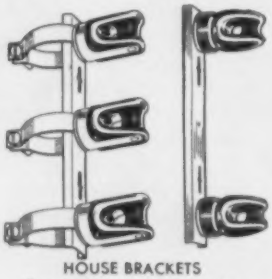
The most complete line of quality secondary service materials available

Every design conforms with industry standards. Racks and house brackets are double hot-dip galvanized for longer service. Wireholder screws are sharp and clean, for quick, easy driving. Dense, homogenous porcelain gives top strength, highest insulation value and sparkling appearance. Your lineman and your budget will like the ease of installation—and the quality—of Porcelain Products' secondary service materials. Write us for complete details.



WIREHOLDERS
Standard and pipe-mounting

SECONDARY RACKS
Solidly constructed for longer service



HOUSE BRACKETS
Standard and pipe-mounting

FOUR-IN-ONE SPOOLS
A wonderful new product

SPOOLS

CLEVISES
For every application

Porcelain Products, Inc.
FINDLAY, OHIO

place of converter except when making measurements. In operation, the meter is used in conjunction with a separate potentiometer.
Charles Engelhard Inc, East Newark, N. J.

Coming New Equipment

Received Too Late for This Issue

Interrupter Switch

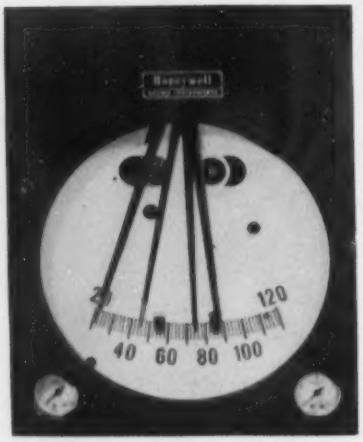
Westinghouse Electric Corp—Is rated 7.5 to 115 kv, at current of 400 to 600 amp

Reel Truck

Moto-Truc Co—Will lift reels weighing 1,600 lb a distance of 14 in.

Side-Break Switch

Southern States Equipment Corp—Is rated 7.5 to 69 kv at 400, 600, and 1200 amp



Indicating Controller

A controller, which indicates and controls two temperatures, is available with a wet and dry bulb system for humidity as well as vapor, gas, or

mercury-filled thermal systems. The temperature range, depending on the fill, is from —125 to +1,000 F. Both thermal systems must be the same range.

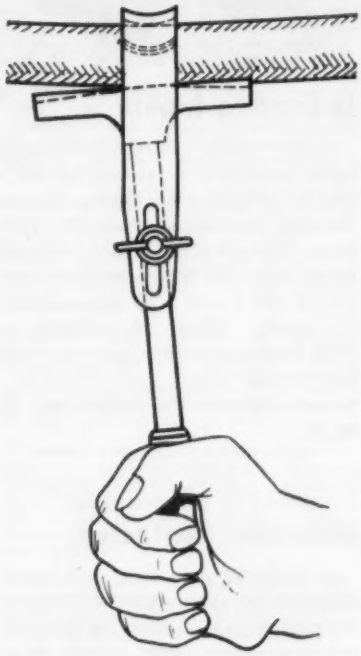
Minneapolis-Honeywell Regulator Co, Wayne & Windrim Aves, Philadelphia 44, Pa.

Circuit Breaker

A Stab-lok circuit, AB-192, features a sequence bussed branch panel making it possible to use 10 single-pole or 5 double-pole branch circuit breakers controlled by one 50-amp main breaker. Four additional 50-amp breakers may be used for major appliances.

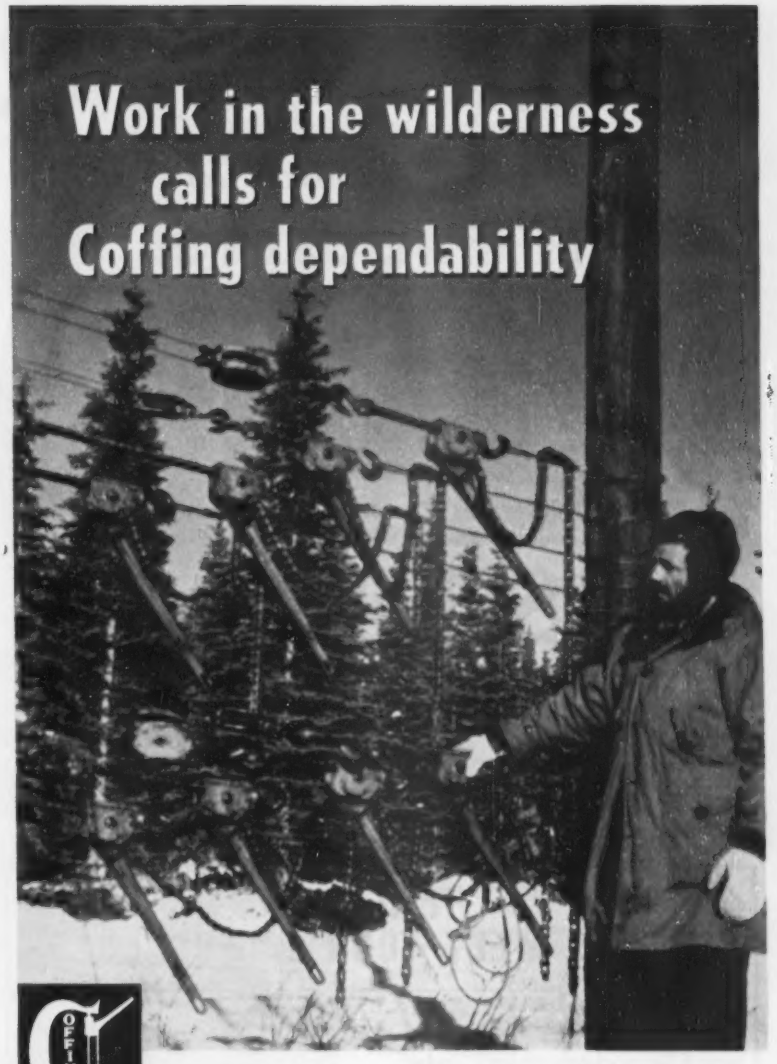
By using a split-bus, five of the breakers in the lower compartment are in parallel with a 100-amp main breaker in the top section. Main line plugs have a capacity of 200 amp.

Federal Electric Products Co, 50 Paris St, Newark 5, N. J.



Conductor Bender

A tool has been developed for bending various large-size insulated cables with resulting minimum damage to insulation. In operation, conductor is placed between adjustable J-shaped



Here, eight Coffing Safety-Pull Ratchet-Lever Hoists are used to stretch spans of wire near Glenallen, Alaska. Other Safety-Pull uses include tightening guys, installing transformers, loading and moving heavy equipment.

On construction jobs in the heart of Alaska, you will find Coffing Safety-Pull Hoists handling the tough pulling, stretching and lifting assignments.

The choice is based on experience. The ratchet-pawl construction, originated by Coffing, gives a positive steel-on-steel action. Its lifting and holding ability is not affected by extreme temperatures. Coffing's record of dependability is also important — especially when working many difficult miles from service and supplies. Every Safety-Pull is designed to handle its rated capacity with a wide margin of safety while its special "Safety Valve" handle protects against overloading damage.

This proved durability is a must in the wilderness and a money saver everywhere. For full information on the complete line of Safety-Pull Ratchet Lever Hoists from ¾ to 15-ton capacity, write for Bulletin E2SP.

COFFING HOIST COMPANY

Danville, Illinois

Quik-Lift Electric Hoists • Hoist-Alls • Mighty-Midget Pullers • Spur-Gear Hoists
Differential Chain Hoists • Load Binders • I-Beam Trolleys

SUPERIOR SWITCHBOARD AND DEVICES • SERVING THE COUNTRY'S LEADING UTILITIES •

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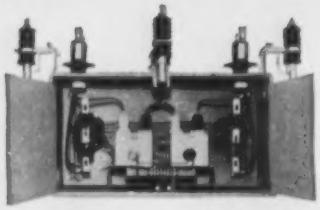

Full range of sizes in standard and top bushing types —all built to Superior's usual high quality. Write to:

SUPERIOR SWITCHBOARD & DEVICES CO.

CANTON, OHIO

A subsidiary of The Union Metal Manufacturing Company

CALL FLINT TO HELP

MEET YOUR POWER LOAD

When erecting electrical substations or transmission towers, always use Flint Galvanized Steel. Flint Galvanized Steel better resists the corrosion of winds and weather and is usually AVAILABLE from our stocks. Be sure to take advantage of Flint's complete services from blue print to erection.

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• WAREHOUSE • REINFORCING
• GALVANIZED

FLINT STEEL CORPORATION

P. O. BOX 1289 TULSA, OKLAHOMA

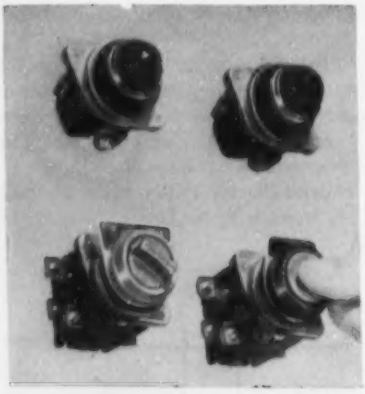
clamping jaw and fixed jaw. Pulling handle bends cable about clamping jaw.

John Teagle, 229 Club Drive, San Antonio, Tex.

Volt-Amp Tester

A snap-around, pocket size, volt-amp tester is now available in three models. Each Amprobe has a 0-150/600 v range and either 0-25, 0-50, or 0-100 amps range.

Pyramid Instrument Corp, Lynbrook, N. Y.



Indicating Lights

Heavy duty, oiltight, indicating lights have been developed for GE's line of oiltight pushbuttons, selector switches, and accessory controls. Featuring all-angle visibility and available in six colors, the lamps are rated from 110 to 600 v with a 10 amp continuous rating. They are available in three forms—resistor, transformer and full voltage.

General Electric Co, Schenectady 5, N. Y.

Magnetic Contactor

A magnetic contactor, said to be adaptable to applications requiring a compact magnetic switch for intermittent or continuous duty, is rated up to 5 hp at 208-550 v. A contact gap of 21/64 in. is advantageous in reversing contactors to avoid flashover during rapid reverses. The contactor is furnished in 2, 3, or 4 poles.

Furnas Electric Co, 1000 McKee St, Batavia, Ill.

CATALOGS • BULLETINS

● **FLUORESCENT FIXTURE:** An 8-page booklet covers Peerlite fluorescent fixtures. Edwin F. Guth, 2615 Washington Blvd, St Louis, Mo.

● **METAL-CERAMIC THERMOCOUPLE:** Thermal conductivity and shock resistance of metal, and corrosion and deformation resistance of ceramics are combined in a new thermocouple protection tube bulletin, P1261. Bristol Co, Waterbury 20, Conn.

● **GEARMOTORS:** A complete line of gearmotors is covered in Booklet B-5645. Westinghouse Electric Corp, Box 2099, Pittsburgh **30, Pa.**

● **TUBE TESTERS, CAPACITANCE METER:** Ten dynamic mutual conductance tube testers are covered by Bulletin TT5A1, and a capacitance meter and vacuum tube volt-ohm-milliammeter is covered by Bulletin 209A2. Hickok Electrical Instrument Co, 10572 Dupont Ave, Cleveland 8, Ohio.

● **DRY-TYPE TRANSFORMERS:** Dry-type transformers from 2½ to 750 kva for general purpose, motor starting, insulation, current phase changing, and rectifying, with Class A or B insulation, is the subject of a new brochure. Jeffries Transformer Co, 1710 E. 57th St, Los Angeles 58, Calif.

● **SERVICE EQUIPMENT:** A four-page bulletin describes and gives applications for the PJ series of fusible service equipment. Murray Manufacturing Corp, 1250 Atlantic Ave, Brooklyn 16, N. Y.

● **LIGHTING EQUIPMENT:** A 16-page brochure covers the Mirac-O-Lite line of cold cathode fluorescent lighting equipment and has some information on application. Cutler Light Manufacturing Co, 2024-28 N. 22nd St, Philadelphia 21, Pa.

● **PRECIPITATOR:** A 20-page booklet, Bulletin 2204B, describes principles of operation, design features, flow diagrams, and applications of precipitators. Permutit Co, 330 W. 42nd St, New York 36, N. Y.

● **COMPUTING EQUIPMENT:** Analog and digital computing facilities available to help solve problems of business and industry is the subject of a bulletin. Armour Research Foundation of Illinois Institute of Technology, 10 W. 35th St, Chicago 16, Ill.

● **CHART RECORDERS:** A four-page bulletin covers Multi-Point circular chart recorders that make six individual records on a single chart. Fielden Instrument Div, Robertshaw-Fulton Controls Co, 2920 N. 4th St, Philadelphia 33, Pa.

● **INDICATING INSTRUMENTS:** An eight-page bulletin, GEC-979A, provides information on applications, features, prices, and performance of Type DP-11 and DP-12 dc indicating instruments. General Electric Co, 1 River Rd, Schenectady 5, N. Y.

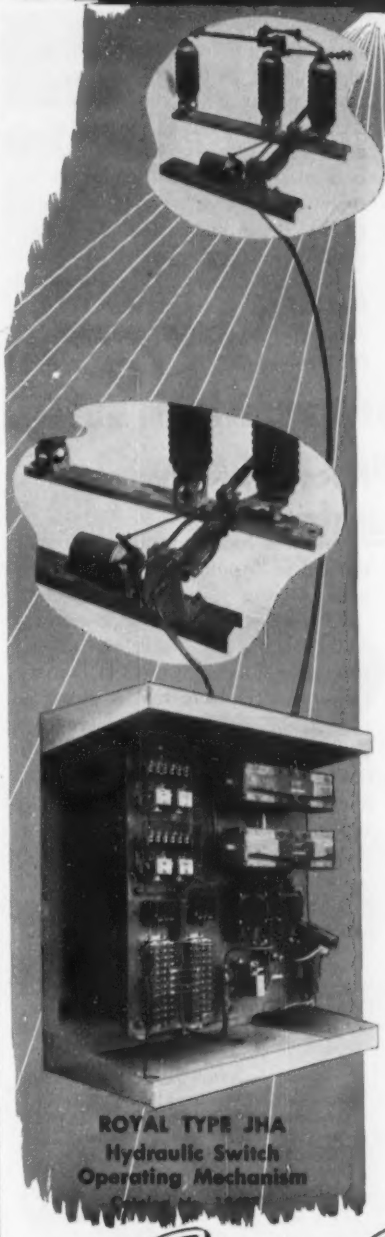
● **FLOODLIGHT:** Bulletin 127-53 describes the improved Series 4000 floodlight that is designed for 750 to 1,000-w lamps. Steber Manufacturing Co, Broadview, Ill.

● **TRANSFORMERS:** Catalog No. 953 covers a complete line of single-phase distribution transformers, 3 to 500 kva, 480 through 67,000 v. Pennsylvania Transformer Co, Box 330, Cannonsburg, Pa.

● **LIGHTING FIXTURES:** Bulletin 554E presents descriptions and technical data for more than 50 pendant, surface-mounted, recessed, and adjustable fixtures. Litecraft Manufacturing Corp, 8 E. 36th St, New York 16, N. Y.

Stored ENERGY

NOW APPLIED TO HYDRAULIC SWITCHING



ROYAL TYPE JHA
Hydraulic Switch
Operating Mechanism

After two years of research and development ROYAL ELECTRIC MANUFACTURING COMPANY, originator of hydraulic-operated power switching equipment, now supplements its popular hand and motor hydraulic units with the new type JHA mechanism, in which energy is stored for instantaneous switching operations, independent of station power. A hydraulic accumulator, employing an inert gas bladder under pressure, stores the energy indefnitely until needed.

ADVANTAGES

- Multiple operation, without station power.
- High-speed operation. Adjustable time cycle.
- Repeated, remote line sectionalizing or tandem switching operations.
- Control and pump motor circuits independently wired, can be fed from the same or different sources.
- Unit will operate two or more switches, with separate relaying for each.
- Pump automatically maintains accumulator pressure.
- For all control voltages. Adaptable to any group-operated switch.

ROYAL hydraulic switch operating mechanisms have been suuplied for several years in hand and motor-operated types. They are easy to install, without elaborate layout drawings. No mechanical linkages are required; slave cylinder is connected directly to switch. Connecting tubing is readily formed for attachment to existing or new substation structures, and can be run underground or overhead to a central control point.

• Catalog No. 12 listing ROYAL connectors, switches and substation fittings has just been published. Write for your copy.

Royal

A Part of the Arsenal of AMERICAN POWER PRODUCTION

ROYAL ELECTRIC MANUFACTURING COMPANY
INCORPORATED
1122 EAST 87th STREET Chicago 19, Ill.

Designers and Manufacturers of Power Switching Equipment and Special Electrical Devices

LETTERS TO THE EDITOR

Two Corrections

To the Editor:

With your forbearance may I note two items in your Jan. 11 issue.

On page 153 the last reference (Anderson-Summons-Woodrow article) should be to the June issue of "Power Apparatus and Systems." The August 1953 issue contains pages 593 to 848.

The caption under Fig 4 page 85 states "Ckva/Tkva equal 0.85" whereas the first paragraph on page 86 in referring to this same figure states ". . . and a Ckva to Tkva ratio equal to 0.5". The difference is not critical and may be a typographical error, but it would be interesting to know which is correct.

Basil Payne
Engineering Department
Nepsco Services, Inc.
Augusta, Maine

• The ratio of Ckva/Tkva was correctly stated as 0.85 in the caption under Fig 4. EW's reference to the August issue of "Power Apparatus" was incorrect. Such constructive criticism is appreciated.

A Hot Subject

To the Editor:

Will some of your readers please comment on the peculiar opinion held by a considerable number of technical personnel, both engineers and electricians alike, that "440 volts is much more deadly than 2300 volts."

I had heard the story for years from electricians, but had never paid very much attention to it; assuming that the idea was caused primarily by the fact that more electricians came into contact with 440 volts, and as a result more of them had been shocked on this particular voltage.

Personally, I have never been convinced that there is any deviation from the long-established principle of Ohm's law, and that in accordance with this theory, the only limiting factor with respect to current flow is the total resistance through a person's finger tips, clothing, boots, and anything else which may be in the circuit. Consequently, the higher the applied voltage, the higher the current.

With the aid of a Variac, a milliammeter and a potentionmeter I once "proved" to a group of linemen, that from zero to 220 volts, there is no exception to the fact that current flow, and consequent discomfort, increases strictly in accordance with the increase in voltage. Also, during the course of the lecture I explained that there is no exception to rule that, the higher the voltage, the higher the danger of electrocution.

Now tell me; did I give these fellows the wrong impression?

Ray L. Miller

Savannah, Ga.

Adequate Comment

To the Editor:

I've just had opportunity to read the article "Appliance Sales vs Inadequate Wiring" in the Nov. 9 issue.

I hope that every manufacturer will read this and take these words very seriously. I have always felt that the manufacturers have had a nice free ride on the adequate wiring program. Considering the effort that the utilities make all over the country the manufacturer's efforts are much too small and entirely disproportionate to the benefits they receive.

I hope that this article starts some real soul-searching. More power to you.

Patrick E. McCaughey
Product Manager
Federal Electric Products Co
Newark, N. J.

Aged in Concrete

To the Editor:

This will refer to pages 92 and 93 of the Dec. 28 issue.

It may be of interest to transmission line engineers that concrete poles have been used successfully in Europe and in other countries abroad for many years. A treatise on "High Voltage Overhead Lines" has been published recently in its second edition. This comprehensive text book by Karl Girkmann and Erwin Konigshofer is available at Springer Publishers in Vienna, Austria. It contains 592 figures and 124 tables on its 655 pages. Transmission line engineers who are interested in concrete towers and poles will find it a most valuable reference.

Eric T. B. Gross
Professor of Power Systems Engrg.
Illinois Institute of Technology
Chicago, Illinois

In Interests of Progress

To the Editor:

In the Jan. 18 issue, I noted your statement about "Instantaneous short-circuit relays" for protection of power plant auxiliaries. It is true instantaneous trips cannot be provided on stalled rotor currents, but we feel that our dual Thermal-Magnetic Bulletin 1180-3 overload relay is a progressive step toward better protection for the A-C motor.

H. K. Liedy
Advertising Manager
Electric Controllers & Mfg. Co
Cleveland, Ohio

Toward Standardization

To the Editor:

The editorial appearing on page 75 of the Jan. 11 issue of Electrical World is a very timely one. You have done an exceptionally good job in bringing forth some of the problems associated with supplying energy to spot networks for servicing large buildings.

As manufacturers, we are now furnishing both 480 delta and 480 wye network transformers; and, in the interest of standardization, the problem should be thoroughly discussed, not only in determining whether the system should be delta or wye, but even as to the proper selection of the voltage when the system is finally adopted.

The proper selection of voltage may have far reaching effects in the operation of a system, especially where large air conditioning load is supplied from synchronous motors.

J. B. Hodtum, Manager
Central Station Engineering Dept.
Pittsburgh Works
Allis-Chalmers Manufacturing Co

TECHNICAL LITERATURE

STAINLESS STEEL CORROSION RESISTANCE—An eight-page folder, TCD 160, contains information on the comparative corrosion resistance of stainless steels to corrosive media. This folder will be of assistance to engineers involved in the selection of stainless tubing and pipe for corrosion resistance applications. Babcock & Wilcox, Beaver Falls, Pa.

METER SOCKET SELECTION—This 19-page booklet, entitled "How to Select Meter Sockets", serves as a guide to the correct selection and installation of GE meter sockets. General Electric Co, Schenectady 5, N. Y.

TABLES OF 10^X—A 543-page book has been published which gives antilogarithms to the base 10, or 10^X, in the form of two tables, a readily interpolable table for 10 decimal accuracy and a basic radix table for 15 figure accuracy. Used in conjunction with logarithmic tables in any extensive computations involving logarithms and antilogarithms, the book will save more labor than will logarithmic tables used alone. Price $3.50. National Bureau of Standards Applied Mathematics Series 27, Government Printing Office, Washington 25, D. C.

SYNCHRONOUS MOTORS—A 16-page bulletin, GEA-5873, explains the electrical operation of synchronous motors and the areas where control is essential. General Electric Co, Schenectady 5, N. Y.

NEMA MOTOR STANDARDS—A 23-page condensation of NEMA's Motor Standards provides standards relating to the rating, performance characteristics, and mechanical construction of motors. National Electrical Manufacturers Association, 155 E. 44 St, New York 17, N. Y.

PLASTICS TESTING—Seven papers entitled "Symposium on Plastics Testing—Present and Future" have been published in a 76-page book. Price $2.00. American Society for Testing Materials, 1916 Race St, Philadelphia 3, Pa.

TRANSISTORS—The theory, circuitry, and general description of two, point contact transistors are contained in a 30-page publication. One type is designed for amplifying purposes, the other for switching operations. Amperex Electronic Corporation, 230 Duffy Ave, Hicksville, N. Y.

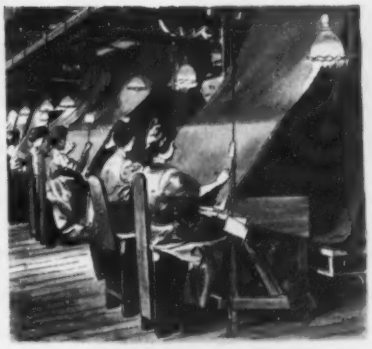
PRECISION POTENTIOMETERS—An eight-page bulletin, "Computing with Servo-Driven Potentiometers", examines linearity and loading effects in analog systems and shows how errors may be eliminated. Practical circuit techniques are discussed, including restriction of potentiometer range, preloading, and unloading with feedback amplifiers. Helipot Corp, 916 Meridian Ave, South Pasadena, Calif.

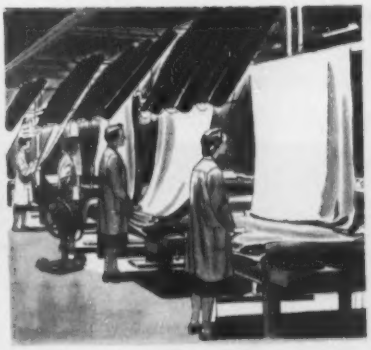
SLIDE RULE—A pocket-size slide rule with A, B, C, D, and CI scales is available upon request. With edges calibrated in sixteenths and millimeters, the rule also bears Ohm's Law formulae and a Fahrenheit-Centigrade conversion scale. Helipot Corp, 916 Meridian Ave, South Pasadena, Calif.

INSULATIONS—A table of simplified thicknesses for 85% magnesia and diatomaceous silica insulations is now available in a four-page bulletin. Magnesia Insulation Manufacturers Association, 1317 F St, N. W., Washington 4, D. C.

METAL SELECTION—A 37 page pamphlet, entitled "A Handbook on Wire—Rod-Strip", is said to be of assistance in the selection of Inco Nickel Alloys. The pamphlet summarizes the physical and mechanical properties of these metals and illustrates typical applications. Alloy Metal Wire Co, Prospect Park, Pa.

HAS YOUR LIGHTING KEPT PACE WITH PROGRESS?





You're always ahead with Sylvania Fluorescent Lamps because of Minimum Heat

Sylvania lamps bring you maximum light with *minimum* heat. Place your hand on a lighted Sylvania Fluorescent Lamp and you will be amazed at the mild, low temperature of the brilliant tube.

In many stores, offices and factories where maintained temperatures are desirable, the coolness of Sylvania lamps becomes a factor of extreme importance.

Important, also, to *any* business, is the fact that Sylvania Fluorescent Lamps offer you written assurance of perfect satisfaction or your money back.*

* Try 24 Sylvania Fluorescent Lamps of any popular type. If, in your opinion they don't give more light and maintain color and brightness for a longer time than any other brand, send them back with your signed Certificate of Assurance and your money will be refunded.

SYLVANIA

Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y.

In Canada: Sylvania Electric (Canada) Ltd., University Tower Bldg., St. Catherine St., Montreal, P. Q.

LIGHTING • RADIO • ELECTRONICS • TELEVISION

NEWS ABOUT PEOPLE

Macleod Made Vice President

Niagara Mohawk Power's newly elected official formerly served as commercial manager of its Western Division

ROB ROY MACLEOD

Niagara Mohawk Power Corp, Syracuse, N. Y., has announced the election of Rob Roy Macleod as a commercial vice president. Macleod, formerly commercial manager of the company's Western Division, will maintain his headquarters at Buffalo.

Macleod has been with the Niagara Mohawk System and its predecessor companies since 1926 when he joined the publicity department of the Buffalo, Niagara, & Eastern Power Corp. Two years later he was appointed manager of public relations.

He was named vice president and general manager of the Bradford Electric Co in 1933, becoming president two years later. When this system company was sold in 1936, Macleod went to Niagara Falls as executive vice president and director of Niagara Falls Power Co and in that same year also was elected president and director of Niagara Junction Railway Co.

Later Macleod moved to Buffalo as a vice president of the System's Western Division companies. When Niagara Mohawk Power was formed in 1950, he was placed in charge of the company's commercial operations in western New York.

A graduate of Boston University, Macleod was in newspaper work before entering the utility field.

V. M. Marquis Assumes New Duties

V. M. MARQUIS

American Gas & Electric Service Corp has announced the promotion of ten key engineering personnel to new positions.

Assigned to new positions were:

V. M. Marquis, formerly vice president of system operation and planning, now is vice president and assistant to the president.

S. N. Fiala, formerly mechanical engineer, now chief engineer and F. A. Lane, formerly electrical engineer, now deputy chief engineer. F. M. Porter, formerly electrical equipment section head, now electrical engineer.

H. P. St. Clair, previously system planning engineer, becomes planning and operating engineering manager. T. T. Frankenberg, former assistant mechanical engineer, takes over as mechanical engineer. G. W. Bice, formerly steam generation section head, is the new assistant mechanical engineer.

Formerly assistant electrical engineer, J. H. Kinghorn is now deputy electrical engineer. H. F. Hoebel, formerly senior engineer of the electrical engineering department, assumes the post of assistant electrical engineer. J. E. Geue, previously plant consultant, is now operating manager of production.

Marquis has been with AGE since 1928, except for a period with the War Production Board during World War II. He was made vice president in charge of system planning and operation in 1950 and prior to that was system planning and operating engineer. He has mechanical and electrical engineering degrees from Stanford University and a master's in electrical engineering from Union College, Schenectady, N. Y.

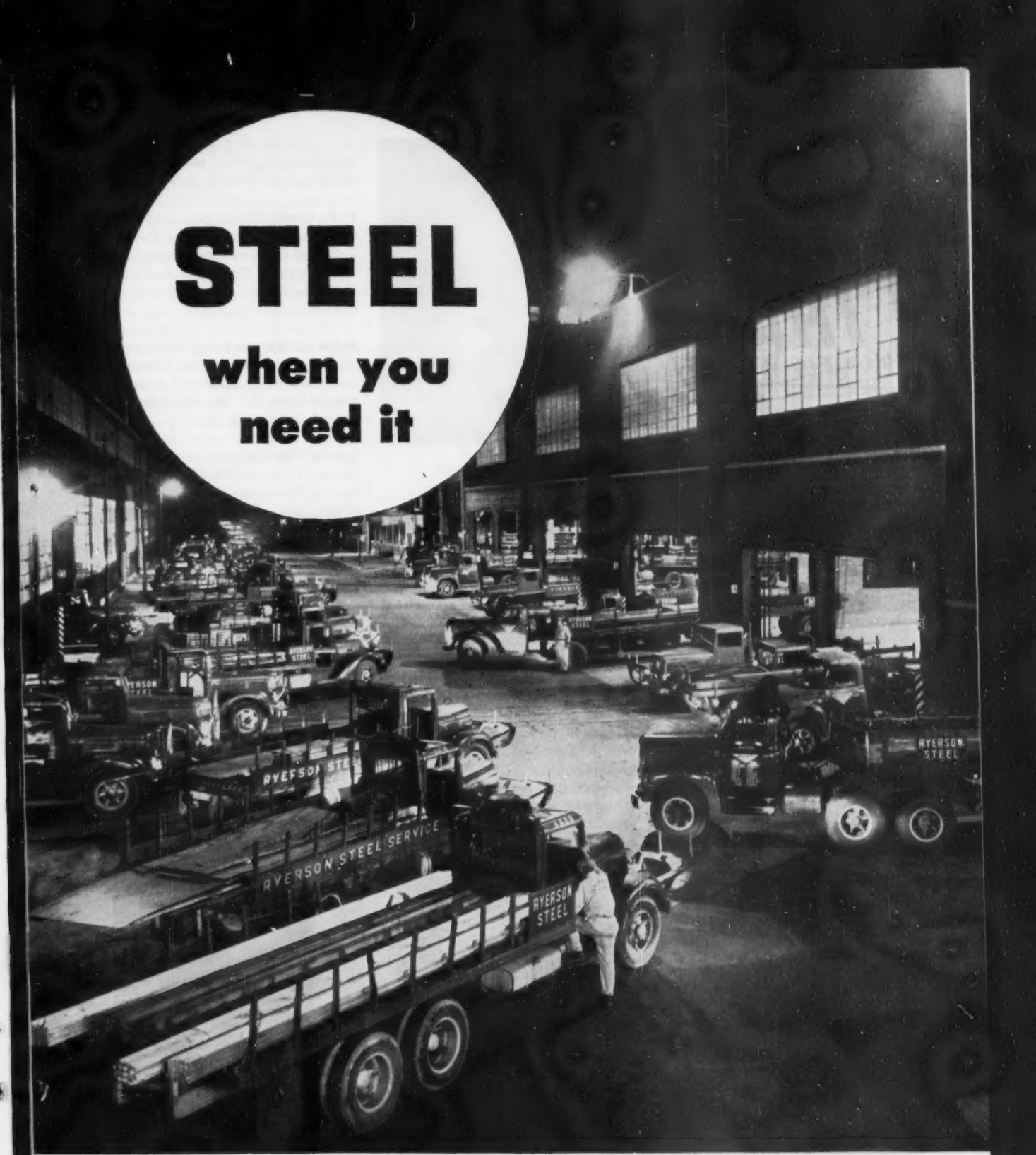
Honeywell Elects 2 VPs; Sweatt Gets Board Post

Minneapolis-Honeywell Regulator Co has announced the election of Tom McDonald and A. M. Wilson

TOM McDONALD

as executive vice presidents. In another appointment, Charles B. Sweatt, executive vice president, was elected to the newly created post of vice chairman of the board of the Minneapolis company.

The new executive vice presidents have played key roles in the company's postwar growth. McDonald has been serving as chief of the firm's expanding worldwide sales organization and Wilson as head of the Aeronautical Division.



● Noon or midnight the loading area of this Ryerson plant looks much the same because we work 'round the clock to make sure that you get Ryerson Steel when you need it. Carbon steel, alloy steel, stainless—every kind is on hand, in practically every shape and size. Your requirements can be set down where you want them, quickly, cut to size and ready for immediate use. Just call the nearest Ryerson plant.

PLANTS AT: NEW YORK • BOSTON • PHILADELPHIA • CHARLOTTE, N. C.
CINCINNATI • CLEVELAND • DETROIT • PITTSBURGH • BUFFALO • CHICAGO
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RYERSON

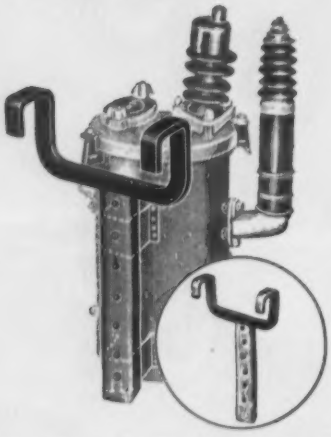
TRANSFORMER HANGERS

LOOK FOR THE NAME

THIEL

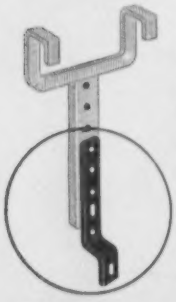
It's a Mark of Quality

Formed from heavy gauge steel . . . hot-dip galvanized for longer life. Available in two sizes. Designed to meet NEMA specifications.



Model	1-Phase	3-Phase	Weight
T-1	3-15 KVA	9 KVA	16¼ lbs.
T-2	25-37-50 KVA	15-45 KVA	37¼ lbs.

HANGER KICKERS



Model K-1 for use with T-1 hanger. Adjusts to four positions. Model K-2 for use with T-2 hanger adjusts to five positions. Kickers and bolts are hot-dip galvanized.

Hangers and Kickers in Stock

THIEL

TOOL AND ENGINEERING CO.

1417 NORTH MARKET ST.

ST. LOUIS 6, MISSOURI

A. M. WILSON

Active in Sales . . . McDonald, a native of Canada, was president of his own company, the T. McDonald Co, Ltd, Toronto, before joining Honeywell in 1931. He headed Honeywell's Toronto sales until 1938 when he was named vice president and transferred to the company's executive offices in Minneapolis.

Wilson joined Honeywell in 1941 as assistant to the president. He was made a vice president of Honeywell in 1943. Prior to his association with Honeywell, he was with J. & W. Seligman & Co, New York investment bankers.

Sweatt has been an executive of Honeywell since it was formed 27 years ago, serving first as vice president and as executive vice president since 1945.

•

J. A. Keogh, vice president and comptroller of Allis-Chalmers Manufacturing Co, has retired. **T. D. Lyons,** assistant comptroller of the firm since 1951, has been made comptroller. Keogh, with Allis-Chalmers since 1904, was elected comptroller in 1932, and a vice president in 1941. Lyons joined Allis-Chalmers in 1937.

Ludwig Skog, senior partner of Sargent & Lundy, Chicago consulting engineers, has retired. Skog joined the staff of Sargent & Lundy in 1910, becoming senior partner in 1947. His successor is **A. Kolflat,** who became affiliated with the firm in 1925.

John B. Crosby, formerly assistant manager of publicity for Crouse-Hinds Co, Syracuse, N. Y., has been appointed advertising manager of the company. With Crouse-Hinds for 11 years, Crosby was assistant to the sales manager before joining the advertising department in 1951.

V. K. Curtis, district manager for the Wire and Cable Division of Copperweld Steel Co in western Pennsylvania, West Virginia, Ohio, and Kentucky, has retired after 29 years with the firm.

Ralph G. Raymond has been named assistant vice president of Commonwealth Edison Co. Raymond, however, will continue his present duties as general division manager.

Sam H. Walk, who has been manager for 31 years at Del Rio, Tex., for Central Power & Light Co, Corpus Christi, Tex., has retired after serving the company 38 years.

Gibbs Elected a VP

Citizens Utilities' former executive aide will be in charge of operating, engineering work

Citizens Utilities Co, Greenwich, Conn., has announced several executive promotions and the affiliation of new personnel.

John C. Gibbs, assistant vice president, has been elected vice president

JOHN C. GIBBS

of the company with full responsibility for operating and engineering activities.

William J. Ieradi has been elected an assistant treasurer in addition to continuing his duties as executive assistant.

New additions to the company's ad-

ministrative group are as follows:

Thomas J. Woods, formerly electrical engineer for Chicago North Shore & Milwaukee Railway Co, joins the company as assistant to the vice president. C. J. Hazard, formerly with Consolidated Gas, Electric Light, & Power Co of Baltimore, Md., joins the company as electrical engineer.

George L. Mumma, previously associated with Johnston Engineering & Management Services, Inc, Fredericktown, Pa., starts his association with Citizens as engineering assistant. Alan A. Stern, previously with Stern, Porter, Kingston & Coleman, New York, will work as an internal auditor.

Gibbs joined Citizens in 1950 as assistant to the president. Subsequently he was appointed engineer and assistant vice president of engineering in 1952. Prior to his association with Citizens, Gibbs was affiliated with Servo Corp of American, Consolidated Gas EL&P, and General Electric Co.

OBITUARY

Dr Karl B. McEachron

Dr Karl B. McEachron, 64, General Electric Co engineer and internationally known authority on lightning protection, died Jan. 24 at Pittsfield, Mass. He became head of the lightning arrester research development section. of GE at Pittsfield in 1922. He served in that post for 11 years and then, until 1945, was head research engineer in the high-voltage engineering laboratory. After serving in several managerial positions, he became in 1952 manager of the laboratory-engineering department of the Transformer Division. In 1953 he was made consultant of professional employee relations, recruiting young engineers throughout the country.

Prior to joining GE he taught at Purdue University and Ohio Northern University, where he was graduated in 1912 and obtained a master's degree in 1913. He received the GE Coffin Award for development of thyrite in 1931 and American Institute of Electrical Engineers' Edison Medal in 1949.

Charles Rump, 69, who retired in 1946 as western Colorado district manager for Public Service Co of Colorado, died recently at Grand Junction, Colo.

THE FACTS OF
LIGHT
...AND THOMPSON
Servisafe
METAL POLE UNITS
FACT NO. 1: Modern parkway and street lighting should be designed for appearance as well as efficiency. In keeping with this trend, THOMPSON now offers an exclusive new Metal Pole Unit that features streamlined beauty and assures peak lighting efficiency at all times.
FACT NO. 2: Only THOMPSON "Servisafe" Units incorporate a patented disconnecting and lowering mechanism that permits rapid . . . safe . . . efficient ground-level luminaire servicing by one man.
FACT NO. 3: THOMPSON "Servisafe" Units eliminate all maintenance hazards. No ladders, scaffolding or lifts are needed for luminaire servicing . . . luminaires can be quickly lowered, relamped and cleaned, and then repositioned from the ground. Electrical dangers are eliminated because lowered fixtures are 'dead'.
FACT NO. 4: THOMPSON "Servisafe" Units facilitate low-cost maintenance by saving man hours . . . reducing accidents. Pole-mounted luminaires now can be serviced at a fraction of normal time and cost.
Write for catalog PB-53 for complete details
1756-TE
1. DISCONNECT 2. LOWER 3. SERVICE 4. REPOSITION 5. REPEAT
THE THOMPSON ELECTRIC CO.
1114 POWER AVENUE • CLEVELAND 14, OHIO

Copper Cutbacks Ordered . . .

. . . by nation's leading producers, Kennecott and Phelps Dodge. Anaconda remains silent on immediate plans

Copper production is tobogganing in the Rockies. Going along on the downhill run are the No. 1 and 2 producers in the U. S.: Kennecott Copper Corp and Phelps Dodge Corp.

Kennecott announced its second cutback in a month on Jan. 27 in the face of "a substantial reduction in the demand for copper." It will force its Nevada mines division to curtail operations to a six-day week beginning Sunday, and the Utah copper division to make a similar cutback the following day.

Phelps Dodge has already embarked on a slight curtailment program that slices its refined copper output by approximately 1,100 tons a month.

This means about a 6% drop from overall monthly production of 18,900 at all its mines.

Round the Clock . . . The mines and plants at both Kennecott properties have been in operation seven days a week and employees have been working 48 hours a week. Under new schedules, Sunday operations will be eliminated and a 40-hour week will be employed.

The action follows one taken earlier, which trimmed monthly output at the Ray mine in Arizona and Chino mine in New Mexico by 1,400 tons monthly.

Production currently is running at 580,000 tons of ore weekly. Under the new setup, 82,000 tons less will be mined and milled each week. No layoffs will result from the latest Kennecott moves.

The Utah division employs about 5,600 workers and the Nevada division some 1,600.

Similar Action . . . Phelps Dodge is making operational cuts similar to those made by Kennecott. It is reducing operations at its two large Arizona open pit mines—Morenci and Ajo—from 6½ days a week to 6 days. Production there has been running about 15,900 tons a month.

No additional production cutbacks are contemplated at the company's other Arizona mines, according to a company spokesman.

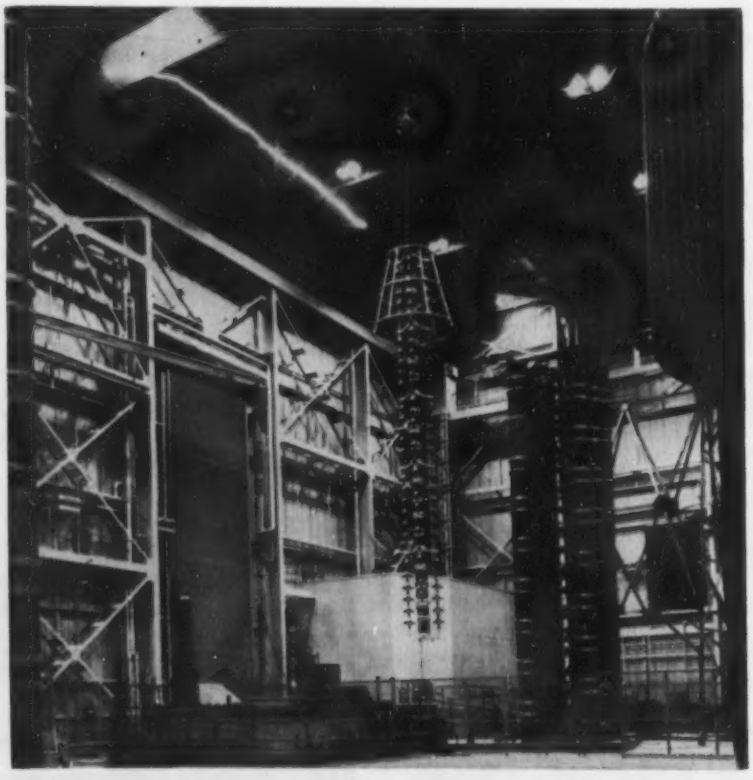
The nation's No. 3 producer, Anaconda Copper Mining Co, was remaining tight-lipped about its plans. One company spokesman would say merely that no cut in production was expected in its Greater Butte projection Montana, or the Yerington project in Nevada.

Westinghouse to Build Top-Rated Transformers

The world's two highest rated transformers are to be built by Westinghouse Electric Corp for Detroit Edison Co. The units will be rated at 315,000 kva each, according to Frank L. Snyder, vice president in charge of the Westinghouse Transformer Division.

The units will be installed at the utility's new River Rouge plant, with the first scheduled to be shipped in 1955 and the second in 1956. Each will boost the power output of a generator from 17,300 v to 129,000 v.

Most powerful transformers previously built are four 190,000-kva



Arrester Takes a 7.5-Million Volt Jolt

Man-made lightning inside General Electric Co's High-Voltage Laboratory at Pittsfield, Mass., strikes a station-type arrester designed to protect a 330-kv power system in Ohio. This system, when operated at the kv rating for which it was designed, will be the highest voltage net in the country.

The arrester unit is rated 264-kv line-to-ground for 330-kv grounded neutral power system and consists of 22 arrester-units of 12-kv rating, each complete with its own valve element and series gaps. It provides a low-resistance path for discharging lightning voltages that strike the line while preventing the flow of power current to ground.

units which Westinghouse built for Detroit Edison's St. Clair Station, first two of which were placed in operation last year.

"Although the two new units are considerably more powerful than any that have been built to date," Snyder said, "they will be only slightly larger in physical size as a result of recent Westinghouse developments in the field of transformer design. Cooling of the new transformers will be accomplished by means of forced circulation of oil and air."

MANUFACTURING BRIEFS

United Nations Education, Scientific & Cultural Organization reports 45 countries and territories are dabbling in television in one way or another. Twenty are on the air; eight are carrying out technical broadcast experiments; and the remainder are taking steps to introduce TV. United States leads in television density, having one set for every 7.15 persons. Cuba, which does not manufacture TV equipment, ranks second with one for every 55 persons. The Soviet Union has one for every 2,400.

Cornell University has begun excavation for its new $1,635,000 electrical engineering center at Ithaca, N. Y. A teaching and research center, it will house the School of Electrical Engineering, the oldest of such schools in the country. The building will take about a year to build and will be named for Ellis L. Phillips, former president of Long Island Lighting Co.

Reynolds Metals Co new aluminum reduction plant near Arkadelphia, Ark., is in operation. The facility, named in honor of the firm's late vice president and director, Robert P. Patterson, has an annual rated capacity of 110 million lb of virgin aluminum.

SALES ASSIGNMENTS

COMPANY STAFFS

Malleable Iron Fittings Co, Branford, Conn., has added the state of Kentucky to the territory of H. G. Putman.

Westinghouse Electric Corp has named Ivan E. McDougal manager of its San Diego office, replacing Ronald T. Strong, who has become an engineering and sales representative for a Westinghouse distributor.

MEETINGS CALENDAR

Pennsylvania Electric Association
System Planning Committee, Hotel Sheraton, Pittsburgh, Pa., Feb. 8-9; Transmission-Distribution Committee, Lord Baltimore Hotel, Baltimore, Feb. 11-12; Prime Movers Committee, Hotel Robert Treat, Newark, N. J., Feb. 15-16; Systems Operation Committee, Fort Stanwix Hotel, Johnstown, Pa., Feb. 18-19; Electrical Equipment Committee, Hotel Roosevelt, Pittsburgh, Feb. 25-26; Relay Committee, Benjamin Frankin Hotel, Philadelphia, March 4-5.

Electrical Equipment Representatives Association
Winter 1954 Meeting, Biltmore Hotel, Los Angeles, Feb. 8-11.

New England Meter Engineers
Demand Register School, New England Power Bldg., Boston, Feb. 8-13.

Edison Electric Institute
Commercial Lighting Committee, Washington, D. C., Feb. 4-5; Transmission and Distribution Committee, Hotel Cleveland, Cleveland, Ohio, Feb. 9-10; Electrical Equipment Committee, Sheraton Cadillac Hotel, Detroit, Mich., Feb. 15-16; Commercial Space Heating and Air Conditioning Committee, Tutwiler Hotel, Birmingham, Ala., Feb. 18-19; Industrial Relations Committee, EEI Headquarters, New York, March 18; 20th Annual Sales Conference, Edgewater Beach Hotel, Chicago, April 5-8; EEI-AGA Accounting Conference, Hotel Statler, Boston, April 12-14; Industrial Relations Committee, Netherlands Plaza Hotel, Cincinnati, Ohio, April 15; Annual Convention, Atlantic City, N. J., June 1-4.

Public Utilities Advertising Association
Region 5 Meeting, Atlanta, Ga., Feb. 11-12; Region 1 Meeting, Sheraton-Mount Royal Hotel, Montreal, Que., Feb. 25-26; National Convention, Hotel Statler, Boston, May 13-14.

Western Computer Conference-Exhibit
Sponsored jointly by American Institute of Electrical Engineers, Institute of Radio Engineers, and Association for Computing Machines Computer Conference Committee, Ambassador Hotel, Los Angeles, Feb. 11-12.

National Association of Purchasing Agents
Mid-Winter Conference, Public Utility, Buyers' Group, Lord Baltimore Hotel, Baltimore, Md., Feb. 15-16.

Public Information Program
Inter-Regional Committee, Blackstone Hotel, Chicago, Feb. 17; East North Central Region, Cleveland, Ohio, Feb. 25.

National Adequate Wiring Bureau
10th Annual National Adequate Wiring Conference, La Salle Hotel, Chicago, Feb. 25-26.

National Electrical Manufacturers Association
Spring Meeting, Edgewater Beach Hotel, Chicago, March 8-11.

Southeastern Electric Exchange
21st Annual Meeting, Boca Raton Hotel, Boca Raton, Fla., March 22-24; Spring Meeting, Engineering and Operation Section, Sans Souci Hotel, Miami Beach, Fla., May 6-7.

***Institute of Radio Engineers**
1954 National Convention, Waldorf-Astoria Hotel and Kingsbridge Armory, New York, March 22-25.

American Power Conference
Sherman Hotel, Chicago, March 24-26.

Northwest Public Power Association
Annual Convention, Winthrop Hotel, Tacoma, Wash., March 31-April 1-2.

***Electrical Industry Show**
Sponsored by Electrical Maintenance Engineers Association of Southern California, Shrine Exposition Hall, Los Angeles, April 1-3.

Pacific Coast Electrical Association
Administration Services Section, Hotel Claremont, Berkeley, Calif., April 7-8; Annual Convention, Hotel Del Coronado, Coronado, Calif., May 19-21.

***Illuminating Engineering Society**
Southern Regional Conference, Roosevelt Hotel, New Orleans, La., April 8-9; Southwestern Regional Conference, Rice Hotel, Houston, Tex., April 11-14; Inter-Mountain Regional Conference, Denver, Colo., April 15-16; South Pacific Coast Regional Meeting, Museum of Art, San Francisco, April 19-20; Pacific Northwest Regional Meeting, Benjamin Franklin Hotel, Seattle, Wash., April 22-23; Canadian Regional Meeting, King Edward Hotel, Toronto, Ont., April 28-30; Great Lakes Regional Meeting, Sheraton Cadillac Hotel, Detroit, May 3-4; Midwestern Regional Meeting, Hotel Jefferson, St. Louis, June 17-19.

***Louisiana Polytechnic Institute**
2nd Annual Instrumentation Conference, Ruston, La., April 8-9.

American Institute of Electrical Engineers
Conference on Feedback Control, Claridge Hotel, Atlantic City, N. J., April 22-23; Northeastern District Meeting, Schenectady, N. Y., May 5-7; Conference on Telemetering, Morrison Hotel, Chicago, May 24-26; Summer General and Pacific General Meeting, Hotel Biltmore, Los Angeles, June 21-25.

American Public Power Association
Annual Meeting, Hotel Morrison, Chicago, May 4-6.

1954 National Telemetering Conference
Sponsored jointly by Institute of Radio Engineers, American Institute of Electrical Engineers, Instrument Society of America, and Institute of Aeronautical Sciences, Hotel Morrison, Chicago, May 24-26.

National Association of Electrical Distributors
Annual Convention, Atlantic City, N. J., June 6-11.

***American Society of Engineering Education**
62nd Annual Meeting, University of Illinois, Urbana, Ill., June 14-18.

American Society of Mechanical Engineers
Semi-Annual Meeting, William Penn Hotel, Pittsburgh, June 20-24.

Michigan Electrical Association
Annual Convention, Grand Hotel, Mackinac Island, Mich., June 27-30.

*Addition this week.

MANUFACTURERS' EARNINGS

Company	Period Months Ended		Net Income 1953	Net Income 1952	Earnings Per Common Share 1953	Earnings Per Common Share 1952
Allied Chemical & Dye	12	Dec.	$45,171,647	$40,305,400	$5.10	$4.55
Colorado Fuel & Iron	3	Dec.	2,380,708	2,026,246	.89(a)	.93(a)
Colorado Fuel & Iron	6	Dec.	4,864,505	2,604,146	1.83(a)	1.18(a)
Cornell-Dubilier Electric	3	Dec.	598,809	404,553	1.14	.75(b)
Johns-Manville	12	Dec.	19,661,412	22,619,951	6.20	7.14

Notes—(a) Based on shares outstanding at close of respective periods; (b) Based on shares now outstanding

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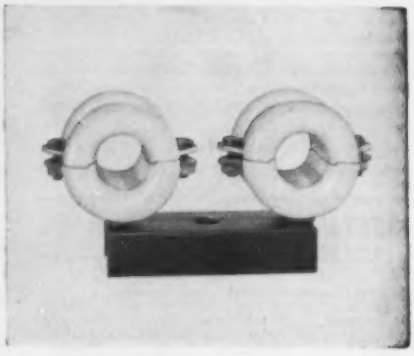
The "Three E" CLAMP INSULATOR SUPPORT is a handy and most useful device in power wiring.

It is easy to install, economical in price and "Three E" has ample stocks to provide prompt shipment.

They are available for insulated conductors ranging from 5/16" to 3½" outside diameter, for pipe or flat mounting, single or multiple conductor.



In factories, mills, mines, power and substations, vaults etc., they make an ideal device for supporting cable runs and all open wiring.

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PRODUCT OF PAGE STEEL & WIRE DIVISION OF AMERICAN CHAIN & CABLE COMPANY, INC.

Pepco Rate Case

(*Continued from page* **96**)

Pepco, no more logically support the allocation of $230,000 of the total rate increase to street railways than they would support the allocation thereto of $130,000, or of $330,000, or of some intermediate amount, with the difference distributed to the other classes of services enumerated in the Order.

"The ultimate requirement of the pertinent statute in the instant case is that the charge made by a public utility shall be 'reasonable, just, and nondiscriminatory.' D. C. Codes 43-301 (1951). I think the court cannot support as reasonable a rate increase allocation for which no understandable reason is shown."

Feather River . . .

. . . project financing through general obligations is proposed by California's Gov Knight

A proposal that the State of California finance the $1.2 billion Feather River Project through general obligation rather than revenue bonds has been advanced by California's Gov. Goodwin J. Knight.

A law already is on the statute books to permit the issuance of revenue bonds. A general obligation bond issue would require a favorable two-thirds vote at a state-wide election. Many believe this would be virtually impossible.

In a talk at an Oroville Chamber of Commerce meeting, Knight admitted approval by the state's voters "might be difficult to get." But, he said, the state bonds could be obtained at much lower interest rates than straight revenue bonds, purchased from investment bankers.

Interest Rates Stressed . . . The governor emphasized interest rates on the project assume great importance "because the more interest we have to pay, the more we will have to charge for the water and power furnished by the project."

Knight made it clear he favors the project and noted "we may find it necessary to construct the major revenue producing portions first, building the rest as revenues accumulate."

"When our final studies are com-

pleted," the governor stated, "I believe we will be in a position to plan ultimate repayment of all reimbursable costs of construction, maintenance and operation entirely from the project's water and power revenues."

The state hopes to gain some federal funds for the project because of non-reimbursable navigation and flood control benefits it will provide.

It was Knight's first major water policy talk since he took over the governorship reigns from Earl Warren, now Chief Justice of the U. S. Supreme Court, several months ago.

The Feather River Project envisages a 3.5 million acre-ft dam near Oroville and a canal system to transport water to Southern California through 368 miles of concrete lined canal, 65 miles of concrete covered conduit, and 117 miles of tunnels.

Envisages Water 'Scramble' . . . Knight said that unless new water supplies are developed "by 1975 we may find our people—20 million by then—engaged in a mad hysterical scramble for every drop of water available."

"We have a problem facing us that could become a nightmare if we do not plan and build now," he emphasized.

Rate Hike for New Mexico Utility Sanctioned by PSC

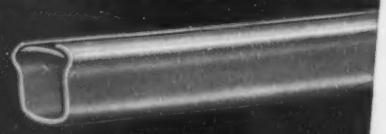
New Mexico Public Service Commission has approved a new tariff designed to carry out a $312,000 rate increase recently granted to the Public Service Co of New Mexico.

The utility serves four principal New Mexico cities—Albuquerque, Santa Fe, Las Vegas, and Deming—but the rate changes affect only the first three.

The PSC said the new rates mean the average residential customer in the Albuquerque area will pay about 50¢ more a month for electricity. Las Vegas customers will get a slight reduction and Santa Fe rates remain almost unchanged. PSC explained this is because the rates in the latter two cities have been higher than basic rates in Albuquerque.

The new rates are to be effective on all billings after Feb. 5 or at the date of integration if that date falls later. In its original order increasing rates, PSC authorized the utility to integrate its operations in the three cities.

WIREMOLD one-piece construction **MAKES WIRING EASIER**



No special tools or gadgets needed! One-piece construction makes vertical runs and overhead installations far easier! Four sizes — for every wiring job, whether new wiring or modernizing present wiring. Definitely the BEST way to wire most buildings, and the ONLY way to wire many buildings! Write for full information!

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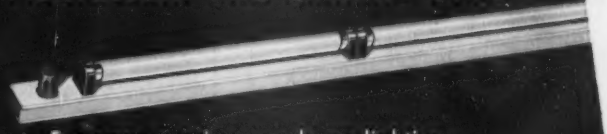

For cove, cornice or valance lighting . . . or supplementary lighting on shelves, counters and display cases, you'll find these Wiremold Units the most useful you've ever worked with. Easily and quickly installed . . . small cross section. Write for full information.

WIREMOLD products are backed by a firm guarantee. See page 7 of Wiremold Catalog No. 19.

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Effectively
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PROTECT UTILITIES PROPERTY

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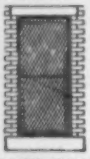
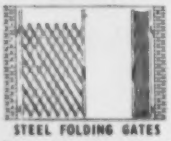


WINDOW GUARDS



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THE STEWART IRON WORKS CO., INC.
2166 Stewart Block, Cincinnati 1, Ohio
Experts in Metal Fabrications Since 1886

Stewart IRON and WIRE FENCES

System Stability

(*Continued from page* 81)

relatively independent. An example that formerly existed is shown in Fig 3. The blocks represent separate operating areas with the interconnecting circuits. The loadings indicated were well within the normal line ratings.

In this case, when load values were exceeded and circuit EB tripped out for some reason, the redistribution of power caused circuit DC, many miles away, to overload and trip out. The resultant power flow split area A into two parts. One operated in synchronism with areas E and D and had an excess of generation. The other part operated in synchronism with areas B and C and had a large excess of load.

The net excess of load over the spinning capacity in the one part of the system mentioned was suffiecient to produce undesirable low frequency. Only vigilance and cooperation of operating forces in such areas make it possible to recognize such situations and avoid them when practicable.

Further information concerning stability problems can be obtained from the following articles: 1. System Stability Needs Constant Attention, Electrical World, Jan. 11, pp 98. 2. The 400-kv Kuibyshev-Moscow Transmission Line, A. V. Minrolyubov and S. S. Rokotyan, "Engineers Digest," January, 1953, pp 26-9. 3. "Electrical Transmission and Distribution Reference Book," Central Station Engineers, Westinghouse Electric Corporation, Fourth Edition, pp 482-3.

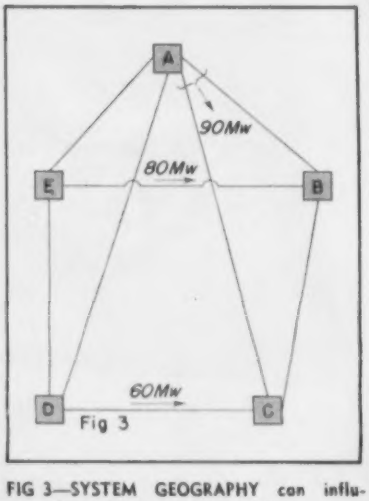

FIG 3—SYSTEM GEOGRAPHY can influence the stability operating limit

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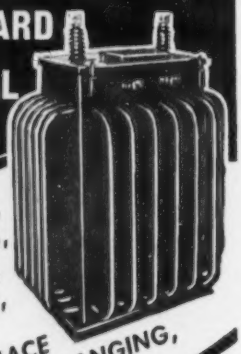

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¼ TO 500 KVA
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UP TO 15,000 V.

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EISLER ENGINEERING CO., Inc.
769 SOUTH 13th ST NEWARK 3, N J U S A

Reclosers

(*Continued from page* 89)

when data was analyzed in this fashion. Cooling curves for all sizes of links are substantially the same.

For a strictly accurate analysis the preloading of the fuse link and ambient temperature should be considered since both affect time-current characteristics.

Heating curves for the 65-amp, Type-T link at preloads of 50% are shown in Fig 3). Similar curves for other sizes of links at 50% preloads can be drawn as described.

Because the fusible sections of a fuse link heat linearly with respect to time, the same heating curve will be followed regardless of the starting point on the curve. For studies at ambients other than 20C start on the heating curve as many degrees above, or below normal as the ambient temperature is above, or below 20C. If the ambient temperature for the study, Fig. 2, were 40C instead of 20C, A would be 20C higher on the heating curve.

Tests to determine how long a link will carry fault current without damage showed that if no visible metal flow had taken place, time-current characteristics of the links were not changed. Furthermore, metal flow did not occur until duration of the fault current was 80 to 85% of the melting time of the link. Thus, a fuse link can operate in the heat of fusion range without having its time-current characteristics altered.

USBR Region VII Reports Ample Power for Needs

Sufficient public power will be available in 1954 to meet all the demands of 25 cities and 39 rural electric cooperatives in Colorado, Wyoming and Nebraska.

Harold Lee, chief of the Power Division of Region VII of the Bureau of Reclamation, said there should be some power left over even for industrial users and private utilities.

Lee said negotiations will begin in March on the applications filed by the 25 cities and 39 co-ops before the Jan. 1 deadline. Applications are for contracts for periods ranging from 2 to 20 years. Lee said no preference customer had failed to file an application.

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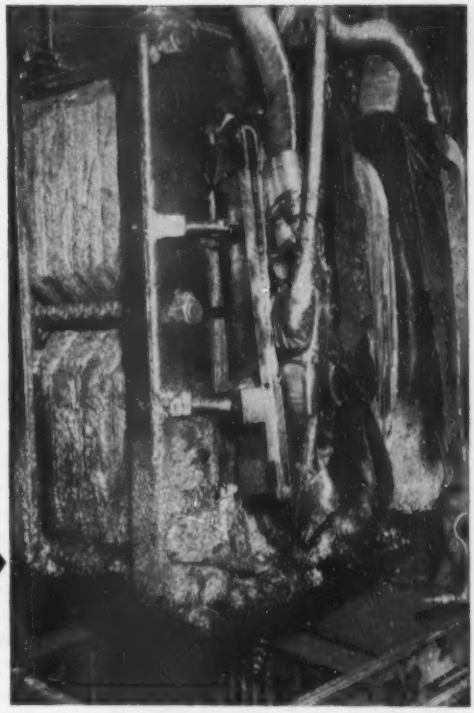

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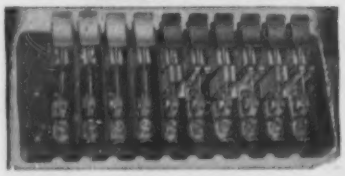

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AIEE Report

(*Continued from page* 79)

3 New Substation Guides

Three guides for substation design prepared by AIEE working groups, a 330-kv substation description, and an evaluation of switching surges within a substation were subjects at a substation symposium.

The guide for minimum electrical clearances, presented by S. C. Killian, Delta-Star Electric, is for use when installing equipment in the field.

"Application Guide on Methods of Substations Grounding," presented by F. R. Longley, Western Massachusetts Electric, shows that 91% of 61 large and small utilities surveyed prefer some type of grid system for grounding.

The third guide covers safety considerations in the design at substations and was presented by H. P. Cadario, Hydro-Electric Power Commission of Ontario.

Design of two 330-kv substations—one rated 1,100 Mva and the other 1,300 Mva—to supply the Atomic Energy Commission at Portsmouth, Ohio, was described by F. L. Musselman, General Electric, and F. W. McCloska, Sargent & Lundy. A "breaker and one half" scheme of switching was adopted and equipment is suitable for breaking 25 million kva.

Analyzer studies indicated that BILs for the transformers could be 1,175 kv and for bus, disconnect switches, and lightning arresters 1,300 kv. However, because of lack of experience with 330 kv, disconnect switches are designed so that an eighth insulator could be added to raise the BIL above 1,300 kv.

Switching surges in excess of lightning arrester sparkover may be obtained on effectively grounded systems using line circuit breakers that won't restrike more than once per phase during an interruption. This was one result of a transient network analyzer study, reported by A. J. Schultz and J. B. Johnson, GE.

Cadmium Aids Distribution

Heavy fortified cadmium plating on aluminum alloy connectors was advocated by D. C. Hubbard, A. B. Chance Co, for joints between aluminum and copper conductors. Claimed advantages are good contact characteristics with resistance to corrosion, organic joint compounds do not affect it, damage to coating does not initiate subsurface corrosion with base metal, and damage to coating has no serious effect on aluminum conductors.

But the cadmium coating must be properly applied to a thickness at least 0.0005 in., he said. And surface treatment extends its effectiveness.

Plating offers no advantage over straight aluminum connectors, commented I. Matthyse, Burndy Engineering Co. Attack on the aluminum is negligible, he said, when compounds are used to assure long service. And on copper connectors Matthyse found flowed-tin better than cadmium plating although his tests were generally similar to Hubbard's.

Assistance to distribution planners is offered by the mathematical method presented by D. L. Hopkins and D. R. Samson, GE. The number of feed points in any survey area is computed directly from permissible voltage drop, load density, and conductor impedance. And similar methods determine the I^2R losses.

For a 600-sq mi area recently surveyed by West Penn Power, W. H. Osterle reported close confirmation of conventional methods of selecting feeding points. But it is still necessary to locate these points by inspection of the area before laying out the subtransmission system.

Distribution voltage unbalance on 4-wire delta combined light and power secondaries has been explored by H. M. Bankus and J. E. Gerngross, GE. Analyzer study of open-delta banks reveals these conclusions:

1. Voltage unbalance is primarily a function of single-phase load.

2. Closed-delta banks are better for small single-phase loads.

3. Large single-phase loads are better served by open-delta banks.

4. Overloading a transformer bank with 3-phase load has little effect on unbalance.

S. W. Anderson, Middle West Service, noted that power factor has little effect on unbalance where large transformers are used. But small transformers may show appreciable effect. In most cases, he added, open-delta installations require less investment.

Omission of the voltage balancing action of motors was conceded by the authors. But they cited examples to prove that the effect is negligible for small unbalance on small motors.

460-V Cuts Building Cost

Basic reasons for grounding or not grounding industrial power systems, and a review of general practices and methods of system grounding are detailed in a preliminary report by an AIEE subcommittee on grounding.

Savings as high as $25 to $30 per kva can be realized when a 480 Y/277-v system is used instead of 208 Y/120 v in modern commercial or office buildings, advised D. L. Beeman, General Electric Co. The load characteristics are much like those of a modern industrial plant. Standard 440-v motorized equipment could be used on 480 Y/277 v or 460 Y/265 v systems which seem to be predominant. Fluorescent lamp ballasts are rated either 265 v or 240-480 v. A 416 Y/240-v system, twice the present network voltage, could be supplied from single-phase 240-v transformers connected in wye. But a new voltage for motors would have an effect on standardization of equipment or a low voltage would be provided for 440-v motors.

Crepe Paper Improves Cable

Cable engineers showed great interest in "two-way stretch" crepe paper insulation. General Electric engineers presented the new paper as an improvement on long-accepted varnished cambric. Increased tensile strength has been achieved, with comparable tear strength and dielectric properties. And the new paper's compatability with askarel is a real advantage.

Discussers reported manila paper better for cable because of 50% higher voltage breakdown. But crepe paper's ability to adjust to sharp bends seemed attractive. G. Camilli, General Electric, suggested use of the new tape for paper-insulated cable joints.

Cyclic movement of lead-covered cable at manholes has been a factor in service life. C. A. Bauer and R. J. Nease, Commonwealth Edison Co, presented a mathematical method for calculating this movement where friction, elasticity, and manhole restraint are known. Attempts to restrain movement by heavy restraint at the manhole only shifts the sheath failures into ducts where they are hard to detect, they warned.

This warning was challenged by R. C. Rifenburg, Consolidated Edison Co, who cited long service life for 300 miles of 3/c 500 MCM 27-kv cable installed through four-foot manholes.

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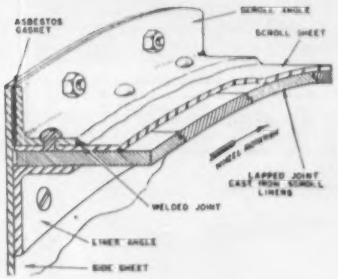

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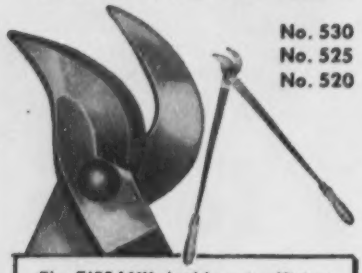

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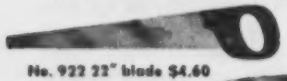

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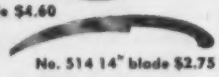

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Installation of the 60-mile submarine cable from Sweden to Gotland was described in a paper by B. O. N. Hansson, Aktiebolaget Liljeholmens Kabelfabrik. Manufactured in 4-mile lengths and delivered in continuous lengths up to 45 miles, the cable was transported through the factory on rollers. Delivery to the laying ship also was accomplished with rollers over factory roofs, along streets and railway tracks and through tunnels to the harbor.

Designed to operate at 100 kv dc, this cable has a single 180,000 cir mil solid copper conductor. Insulation is 100 layers of oil-impregnated paper totalling 0.275 in. and tested to 425 kv dc after bending. Covering is two concentric thin lead sheaths protected by jute and steel armoring.

Pipe Alters Cable Impedance

In attempting to collect test data on pipe-type cable and from it deduce the zero sequence impedance E. R. Thomas, Consolidated Edison of N. Y., found the data didn't fit together with any rhyme or reason. He found that when the pipe is bonded at its ends to an external conductor, a negligible portion of return current flows in this external circuit. Thus, Thomas concluded, bonding the pipe to external ground paths will not change the single-phase impedance values to any measurable extent. With the single-phase impedance of the pipe return circuit independent of the conductor size, he found the usual zero-sequence impedance measurement gave almost the same value as if the total current flowed in only one conductor.

Thomas warned that high values of pipe voltages to ground can develop unless terminal grounds on pipe-type cable are well maintained.

Limitations in applying the four prevailing procedures for calculating the capacity of single pipe-type cable systems have led M. Morris and R. W. Burrell, Consolidated Edison of N. Y., to develop a new empirical method which modifies the well-known "equation No. 2" of present procedures.

Where soil surrounding an underground cable line is a poor heat conductor the best solution is the substitution of a soil that does have good thermal conductivity. Tests of several substitute soils reported by L. H. Fink, Philadelphia Electric, showed silic sand available there.

Cessation of the city's trolley lines and the loss of the cathodic protection afforded by the rails, has resulted in an increase in corrosion from dissimilar metals according to a paper by F. E. Kulman, Consolidated Edison Co of N. Y. Protection in non-stray current areas is being obtained through the use of protective coatings or cathodic protection, he said.

Techniques of installing pipe-type cable in New York and Detroit were compared by R. W. Gillette, Consolidated Edison Co of N. Y., and F. M. Hull, Detroit Edison Co. Pulling lengths for 1,500 MCM pipe cable rated 138 and 120 kv for both companies were about identical—3,000 and 3,200 ft respectively.

During the first 14 months' operation nine cable failures were experienced on a 120-kv, self-contained, compression cable installed in Montreal. S. H. Cunha, M. P. Gunning, and D. M. Farnham, all of Quebec Hydro Electric Commission, reported that the cable in trouble was identified by loss of gas pressure from 200-lb nitrogen. Seven failures were mechanical and two electrical.

Six mechanical failures occurred in underground ducts as breaks in the outer rubber-sandwich sheath. Brass reinforcing tapes under the sheath disintegrated rapidly in the presence of moisture. The seventh failure occurred on a bridge as a hair-line crack in the pressure retaining sheath.

Both electrical failures occurred on the bridge where design temperatures were specified as −35C to 35C. One failure during the winter was due to a slight leak in the inner sheath.

Measure Transformer Noise

Transformer discussion concentrated on the report submitted by the AIEE Transformer Committee's Working Group on Audible Noise. Permissible noise level near a transformer, they found, depends upon these factors; distance to nearest residence, background noise level, prevailing atmospheric conditions, terrain, surrounding buildings which may reflect noise, or act as barriers.

Loudness level they find the preferable measure of disturbance. But it requires frequency analysis and complex computations. The octave band analyzer is proposed as best method for determining loudness.

Proposed temperature limits for transformer windings during fault con-

ditions were shown by J. E. Clem, Consulting Engineering & Test Inspection Services, to include margin for reclosing practices. Cooling after fault is slightly slower with successful reclosure. And additional reclosures for 10 to 20% of faults adds heating. But clearing times well within limits for most faults provide ample margin. he concluded.

New Breaker Rating Method

General approval greeted a new proposal for rating power circuit breakers that promises a simplified application procedure as one main advantage. Culminating almost two years of effort by the switchgear committee's working group on breaker ratings, the new proposal offers a completely new term—rated short-circuit current—to replace the several existing current ratings. Rated short-circuit current specifies the short-circuit current and its characteristic variation with time that the breaker is required to close, carry and interrupt.

While the general tone of the proposed rating was hailed, need for clarification of some points was indicated. O. B. Vikoren, Philadelphia Electric, said the proposal appears to reduce the present ratings of 3-cycle breakers by 20% and 5-cycle breakers by 10%. Modifications were presented by P. R. Spracher, Virginia Electric & Power Co, to cover delayed tripping operation.

Good correlation between the variation with time of the maximum rms short-circuit current in the proposal with actual field tests by the Bonneville Power Administration was reported by E. C. Starr, Oregon State College.

Summing up the new proposals, R. M. Bennett, chairman of the subcommittee on power breakers, said the new rating makes standards rigorous and more understandable. It greatly simplifies the understanding of breaker ratings. Manufacturers will have to make certain that breakers will close and latch against the maximum short-circuit current.

A proposed guide for ice testing of outdoor disconnects was submitted by the switches, fuses and insulators subcommittee working group. Replies from 17 operating companies, covering the 1951-52 season, plus replies covering severe icing conditions during the 1952-53 season brought out significant points:

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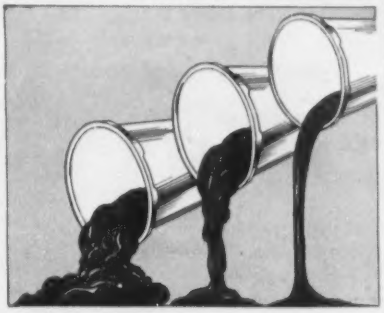

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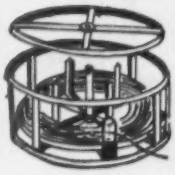

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Private Plan. . .

. . . outlined for purchase, distribution of power from proposed Colorado River Project

Nine private electric companies serving the Upper Colorado Basin issued a joint statement late last month asking for federal-private power cooperation in marketing power generated by the proposed Colorado River Storage Project.

The plan calls for purchase by private companies at "reasonable" rates of project power not contracted for by preference customers. The power would be purchased either at the project plants or along their tie line, and transmitted and distributed over the companies' own power systems.

Plan Presented at Hearing . . . The statement was submitted at hearings on the proposed project currently being held by the Subcommittee on Irrigation and Reclamation of the House Interior and Insular Affairs Committee. It was presented for the electric company group by D. D. Moffat, Jr, assistant to the president, Utah Power & Light Co.

The companies involved are: Arizona Public Service, Public Service of Colorado, Public Service of New Mexico, Southern Colorado Power, Southern Utah, Southern Wyoming Utilities, Telluride Power, Western Colorado Power, and Utah Power & Light.

Principles for Cooperation . . . The plan was issued in a seven-page joint statement outlining six principles for government-private cooperation in the disposition of electric energy from the storage project. These are:

1. The holdover reservoirs and power plants should be built by the federal government because of the magnitude and multiple-purpose of the project.

2. The government should build the backbone transmission tie line connecting major power plants of the project, except where interconnections can be made more economically through the private companies' present and projected systems.

3. Use should be made of the then existing transmission systems of the companies and such new ones as the companies may construct from the project plants or tie lines, in order to

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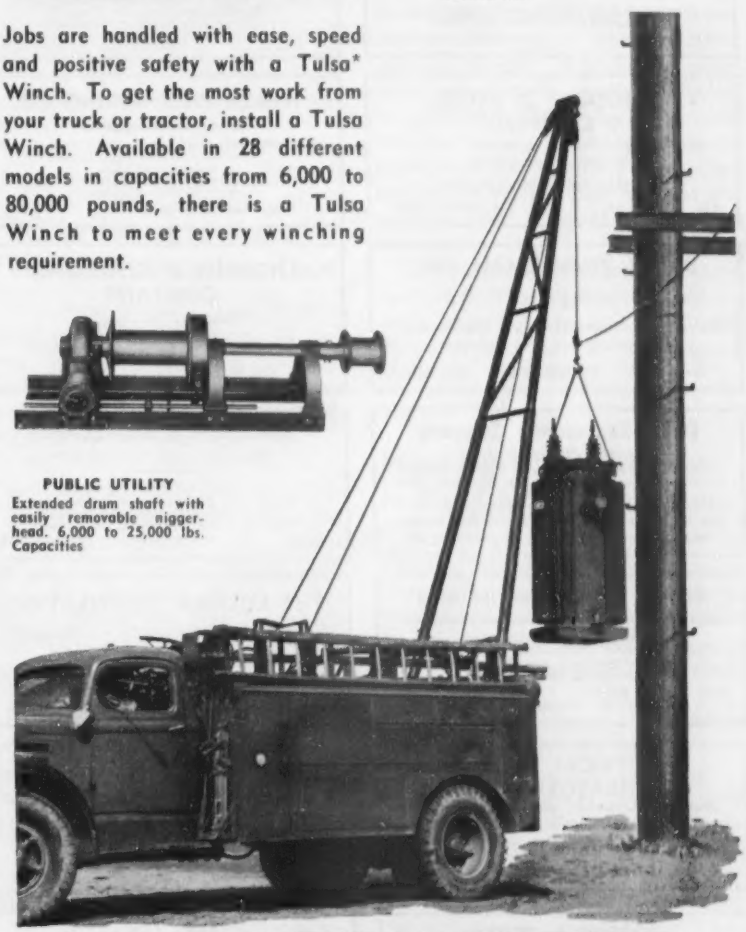

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4. The companies are willing to deliver project power to preference customers for reasonable transmission charges, or to supply all power to preference customers at rates which will pass on savings from purchase of project power.

5. The financial feasibility of the project depends upon the sale to private utilities of the power output of the project plants not contracted for by such customers as may be entitled to preference; the cost of power to private companies at the project plants or tie line should not exceed cost of power from alternate sources.

6. Rates charged by the companies for electric service including project plant power would be subject to full jurisdiction of the appropriate state utilities commission.

The statement urged that an understanding be reached in order that the companies might plan, design, and construct new generating and transmission facilities to coordinate with the project development.

FPC Is Asked to Deny Permit for Boundary Dam

The Pend Oreille County PUD of Newport, Wash., has asked the Federal Power Commission to deny Seattle City Light's application to build a power dam on the Pend Oreille River at the boundary site.

The proposed boundary dam would "completely overflow and destroy" the "Z" Canyon site the PUD has purchased for development after completion of its Box Canyon dam next year, the PUD declared. Seattle is prohibited by state law from condemning the PUD's properties and rights, contended the petition filed with the FPC.

Two lead-zinc mining firms whose properties would be flooded also have protested against the proposed boundary dam. They are Pend Oreille Mines & Metals Co. and American Zinc, Lead & Smelting Co.

Pend Oreille Mines charges that construction of the dam would cause the company and the national defense effort "irreparable damage."

American asserts that raising the river level to 1,990 ft, as Seattle City Light proposes, will raise the water 65 ft above current workings and 1,030 ft above ore bodies to be developed later. Some 85% of known commercial ores in the Metaline district, declare the two mining companies, are located below 1,700 ft elevation.

Seattle OK's 20-Year Pact between City Light, BPA

The City of Seattle has accepted a new 20-year contract between Seattle City Light and the Bonneville Power Administration previously approved by the Department of the Interior.

The revised draft was submitted to the Council's utilities committee, which recommended approval by the city. The new contract will replace a five-year contract which will expire in 1957.

Several changes were made from the original draft of the contract. Seattle, looking ahead to the possibility that the federal agency might some day be unable to meet the full requirements of Seattle City Light and other public distributors, secured inclusion of a requirement that Bonneville give five years' notice of intention to apply a provision that all public agencies be held to the supplies they received the previous year, in event of a power shortage.

In the revised contract, only new loads of 10,000 kw or more would require Bonneville approval, double the limitation proposed in the original draft.

Washington PUD's Urged to Buy Chief Joseph Dam

Rather than build new dams, the Chelan, Okanogan, and Douglas County PUD's of central Washington State should attempt to purchase Chief Joseph Dam from the federal government, a public leader of the area has suggested.

The suggestion was made at Chelan by Art Garton, former state director of conservation and development.

All three of the PUD's have filed applications with Federal Power Commission to construct low-level dams. Garton believes it would be cheaper for them to buy Chief Joseph from the government, under the Eisenhower Administration's plan to return public power projects to local authorities.

Chief Joseph Dam, costing nearly $200 million, will have an ultimate capacity of 1,728,000 kw.

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P-1391, Electrical World
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1100	General Motors	16-278A	1600	720	200	General Motors	6-268A	350	900
750	General Motors	12-567	1080	720	150	Worthington	CC-4	225	450
500	Baldwin	VO-8	750	514	150	Ingersoll-Rand	S-4	235	600
500	General Motors	8-278A	750	720	150	Buckeye	80	240	600
500	General Motors	8-567	720	720	100	Worthington	BB-5	150	600
480	Worthington	DD-8	700	360	100	General Motors	3-268A	150	1200
400	Ingersoll-Rand	S-8	600	720	60	General Motors	6-71	90	1200
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1	—1000	G.E.	Non-Cond—190 lbs—2400—3—60
1	—1000	Moore	Condensing—Extraction—190 lbs., 2400—3—60—Surface Cond.
1	—750	G.E.	Condensing—265 lbs., 440—3—60 Built 1944
1	—500	Moore	Non-Cond—150/200 lbs., 5/35 lbs. B.P., 480—3—60 Dir. Conn. Exciter
1	—300	G.E.	Non-Cond—150/175 lbs., 5/10 lbs. B. P., 480—3—60

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Qu.	Kva	Make	Cycles	Voltages
1	—13900	Whse.	25/60	13200 x 13200
1	—3750	G.E.	25/60	4150/2400 x 2400/4150
1	—3125	G.E.	25/60	4150/2400 x 2400/4150
2	—2500	G.E.	25/62½	2300 x 4160
1	—1250	G.E.	25/58.3	4400 x 2300
1	—625	A.C.	25/60	11000 x 2300

MOTOR GENERATOR SETS
3 ph, 60 cy.

Qu.	KW	Make	Speed	DC Volts	AC Volts
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2	—3000	G.E.	450	250	2400
2	—2000	G.E.	514	600	6600/13200
1	—2000	G.E.	500	600 25 cy.	11000
2	—1750	G.E.	514	250	2400
1	—1500	C.W.	514	115	4000/13800
1	—1500	G.E.	720	600	13200
1	—1000	G.E.	900	260	4100/6900
2	—1000	Whse.	900	600	2300/4150
1	—750	Whse.	900	275	2300/4150
1	—500	Whse.	1200	125/250	2300
1	—500	Whse.	900	250	440
1	—500	G.E.	720	125	2300

TRANSFORMERS—60 Cycle

Qu.	KVA	Make	Type	Ph	Voltages
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1	—3500	G.E.	WCT	3	13800 x 2300/440
1	—2500	Whse.	OISC	3	26400/13200 x 480
3	—2000	G.E.	HVDDJ	1	66000 x 13800
3	—1250	G.E.	HVDDJ		6600/550
3	—1000	G.E.	HVDDJ	1	2200/480

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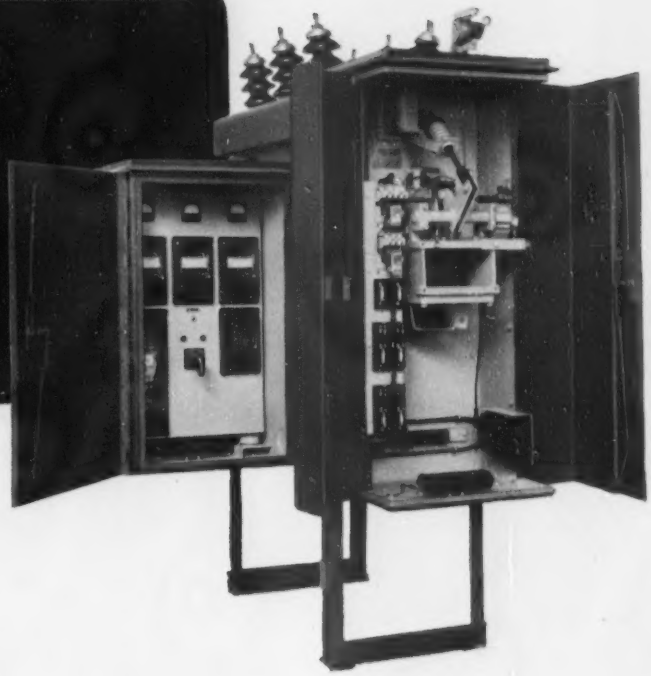

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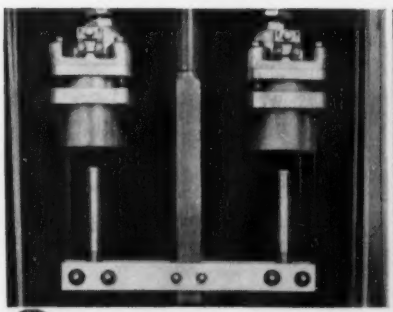
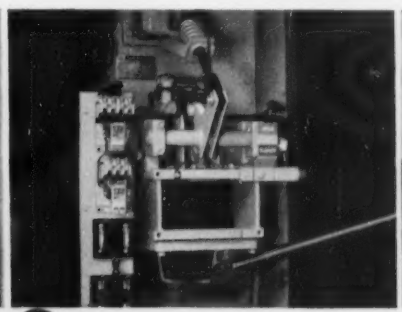
NO FALSE OPERATION of relays. Operate the breaker — slam the door — or let the wind slam it and relays can't operate accidentally. Relay panel is in separate cabinet from operating mechanism and is 4-point mounted on shock absorbers. No hinge wiring either! Separate door in rear of cabinet provides access to back of relays.





FLIP AND BAYONET CONTACTS are self wiping, self aligning. Note also, double break per pole design and time-proved *Ruptor* interrupting device are used. Here again, Allis-Chalmers is using the same quality construction as is used on large A-C breakers.

VISIBILITY PLUS. Maintenance closing device is side operated. Man closing breaker can observe contacts and man working on them. In addition, external position indicator easily visible at a distance from front or side. Inside position indicator also provided.

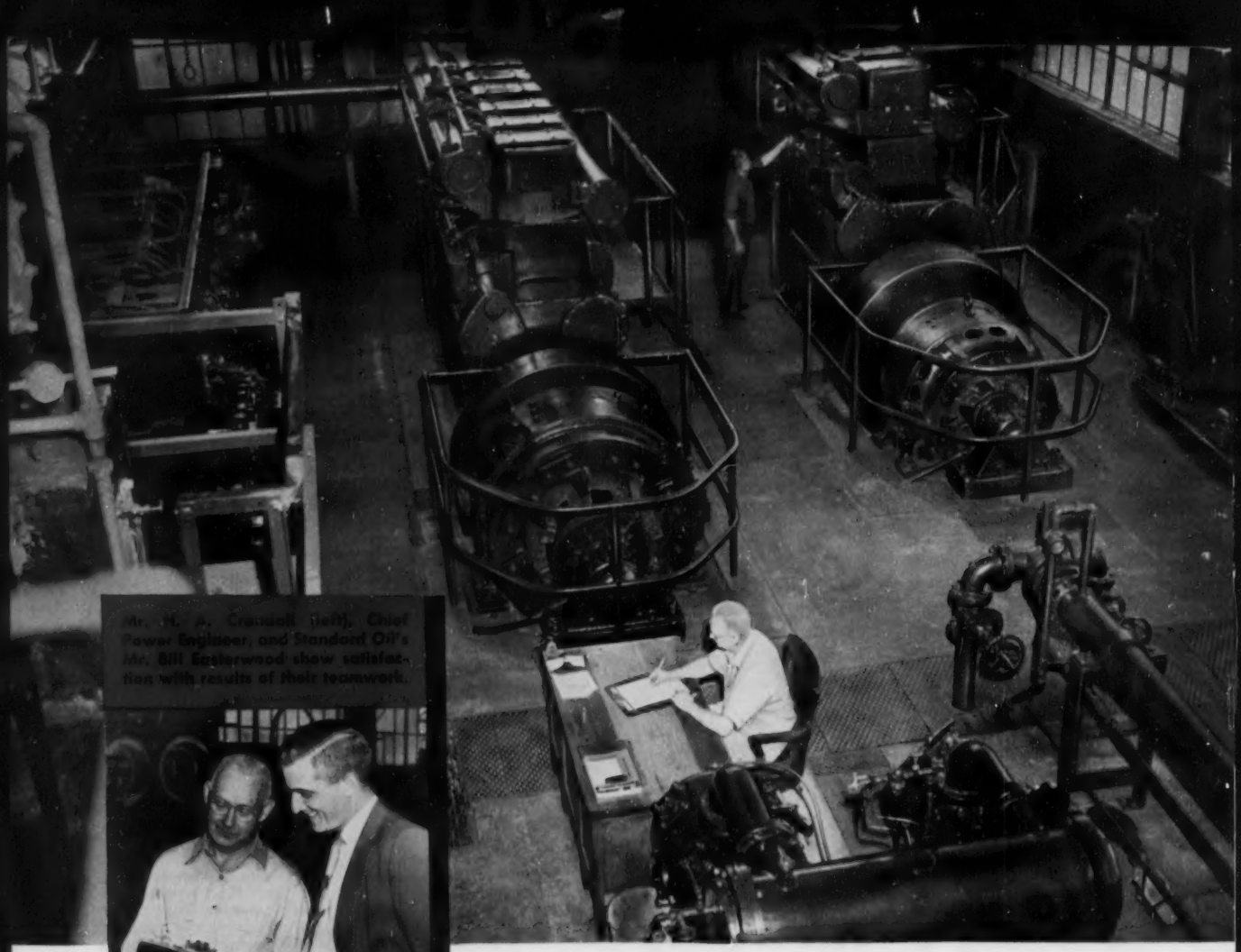
NO BURIED LEADS. Simply remove three pins at bottom of fabricating wiring duct to expose bushing current transformer leads. No conduits, pipes, fittings to remove. This is just one more feature that makes this the outstanding distribution-type breaker today.

GET COMPLETE INFORMATION. Call your nearby A-C district office, or write Allis-Chalmers, Milwaukee 1, Wisconsin.

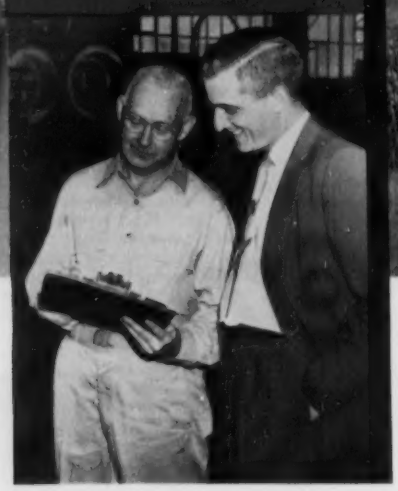
A-4255

Ruptor is an Allis-Chalmers trademark.

ALLIS-CHALMERS



Mr. H. J. Crandall (left), Chief Power Engineer, and Standard Oil's Mr. Bill Easterwood show satisfaction with results of their teamwork.



Here's a 27,000-hour record for low wear and clean operation!

● This diesel power plant serves a large midwest manufacturer of steel products.

The plant superintendent was increasingly aware that lubrication of his two diesels was not all that it should be. There was trouble with stuck rings, and crankcases showed excessive deposits. Working with a Standard Oil lubrication specialist, the superintendent switched his engines to STANDARD HD Oil.

During some 27,000 hours' operation of each unit, engines have remained exceptionally clean. Ring sticking troubles have been eliminated. Cylinders have shown less than 0.01″ wear — a reduction of 50% over the previous, similar period. Neither of the original fills of STANDARD HD have needed to be replaced.

Midwest diesel operators are getting record efficiency and economy with the help of STANDARD HD. Your Standard Oil lubrication specialist can help you get similar results. Phone your local Standard Oil office. Or, write: Standard Oil Company, 910 South Michigan Ave., Chicago 80, Ill.

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